Curyung Tribal Council

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Col. Philip J. Borders Alaska District Commander U.S. Army Corps of Engineers P.O. Box 6898

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March 23, 2020

SUBSISTENCY

RE: Pebble Project (POA-2017-00271), Curyung Tribal Council Comments on Preliminary Final EIS and the NEPA Process, and a Request for Government-to-Government Consultation

Dear Colonel Borders and Mr. McCoy:

In our role as a cooperating agency for the Pebble Project Environmental Impact Statement (EIS), Curyung Tribal Council (Curyung) hereby submits: (1) our comments on the cooperating agency technical meeting notes for the March 2020 meetings; (2) our technical comments on the Preliminary Final EIS (PFEIS); and (3) supporting materials for incorporation into the EIS.

We reiterate our concern that 45 days was not sufficient time to review and provide meaningful feedback on the PFEIS given the breadth of changes to the project proposal and EIS analysis, which has been compounded in the last two weeks by the outbreak of COVID-19 limiting tribal resources, as well as distracting from the tribe's role in important and urgent COVID-19 response measures for our community. In this time, we have been on multiple teleconferences with the Federal Emergency Management Agency, Health and Human Services, Indian Health Services, Bureau of Indian Affairs, state, military and municipal partners, tribal health care organizations, and others. We have crafted and adopted emergency plans and issued important disaster declarations that open the door to critical aid for our tribal members. In fact, Pebble is the only issue that we work on where deadlines have not been adjusted out of a sensitivity to the current National Emergency; a fact that is inexplicable to us.

It is clear from our participation in the cooperating agency technical meetings and from our review of the PFEIS that the Corps is not looking at the full potential impact of the proposed Pebble mine on fish, wildlife, or subsistence as required under NEPA. This is evidenced in our notes from the March 9-11 meetings attached to this letter. Overall, Curyung objects to the Corps' near-wholesale deferral of project analysis to the state permitting process on a variety of important issues such as tailings dam designs and quantifying impacts to fish habitat and water quality. This deferred analysis makes the PFEIS document deficient. Moreover, Curyung has particular concerns with the PFEIS's inadequate characterizations of subsistence and salmon habitat and insufficient analysis of impacts to salmon, salmon habitat, wetlands, streams, wildlife, regional infrastructure and cultural resources; as well as improperly limiting analysis of tailings dam failures, downstream impacts, and mine expansion and economic feasibility. Our specific concerns with the PFEIS are detailed in technical comments attached to this letter.

Curyung once again reiterates our objections to the Corps' NEPA process and failure to commit to issuing a new Draft EIS for public review despite more than a dozen project changes, voluminous new information submitted by the Pebble Limited Partnership (PLP) since the Draft EIS was released, remaining data gaps and missing analysis, and a new compensatory mitigation plan lacking public review. NEPA mandates an

opportunity for the public to review the voluminous changes to PLP's proposed project and new analysis of impacts, all of which post-date the Draft EIS, prior to the Corps issuing a Final EIS for the project.

Curyung thus formally requests government to government consultation meetings with you and your staff regarding a 404 permit application and compensatory mitigation for the proposed Pebble Mine Project. From our previous government to government meetings, our review of the PFEIS, and our participation in cooperating agency meetings, Curyung has serious and unresolved concerns with the NEPA and 404 processes, such as major data gaps and flaws in the EIS analysis, concerns about the inadequate analysis of the impacts to salmon and subsistence and Curyung tribal members and our community and neighbors, and concerns with an inadequate compensatory mitigation plan. Any 404 permit issued to PLP based on the current project design, insufficient compensatory mitigation, and lacking analysis of impacts to waters and salmon would result in significant adverse impacts on important fish, wildlife, subsistence, and aquatic habitats and would be contrary to the public interest. Based on the record before the Corps, Curyung strongly recommends denial of a 404 permit to PLP. We would like to discuss the basis of our recommendation that the 404 permit be denied in government to government meetings with the Corps.

The Corps promised the cooperating agencies and public a meaningful and robust NEPA process for the proposed Pebble Mine Project. The Curyung Tribal Council believed we could assist in achieving this aim through participation as a cooperating agency. We would be remiss in these – our closing remarks as a cooperating agency — if we did not clearly state to you that the NEPA process to date has not been meaningful or robust for our tribe and its members, and we believe to the people of Bristol Bay and Alaska in general.

As but one example, the Corps has been solely schedule-driven in its decision-making. It has cast aside many legitimate requests of tribes, Bristol Bay residents and stakeholders, and independent and agency experts, for more time to review, understand and provide meaningful input on the Pebble Project Clean Water Act 404 permit application and associated and voluminous information related to its potential impacts on Bristol Bay, its salmon and people. Not once has the Corps cleanly identified a national interest that would justify its rushed and intentionally-blindered NEPA process over the interests of tribes, Bristol Bay residents and other stakeholders, and Alaskans in general, in such a meaningful and robust process.

We would also be remiss if we did not express our disappointment in the Corps' handling of the cooperating agency process. The Curyung Tribal Council did not lightly accept your invitation to be a cooperating agency, as we knew the economic and opportunity costs to us of committing to your process would be high. Yet we felt we owe it to our members to do what we can to ensure that the project applicant and the federal permitting authorities meet their burdens for a project as fundamentally risky to Bristol Bay, its salmon and people, as the proposed Pebble mine. Yet, from the beginning the Corps sought to artificially limit the input of cooperating agencies to narrow issues, especially including limiting the role of tribal participants. The Corps also rejected, also without understandable justification, requests for more time for cooperating agency review and input of critical NEPA documents (including due to the current National Emergency). And on the substance, the Corps seems to equate the act of listening to issues raised by cooperating agencies with meaningfully addressing those issues. Time and again, including as reflected in the notes from the recent technical meetings, the Corps would only acknowledge as action items those issues which can be addressed without impact on its desired schedule, and reject or gloss over any suggestions that would threaten that desired schedule. Along with other tribes from the region, we are the experts on Bristol Bay, and yet the Corps' repeatedly shunted aside our input. Our frustration is acute.

In conclusion the Curyung Tribal Council does not believe that the Clean Water Act and NEPA permitting processes for the proposed Pebble mine, to date, have integrity, and in our view neither the project applicant nor the Corps has met their burdens to ensure informed decision-making about the proposed Pebble mine.

Sincerely,

Thomas Tilden

First Chief, Curyung Tribal Council

Courtenay Carty

Trial Administrator

Enclosures

- 1. Curyung Tribal Council's comments on cooperating agency meeting notes for meetings held on March 9-11, 2020.
- 2. Curyung Tribal Council's technical comments on the Preliminary Final EIS
- 3. Supporting materials and reports

Curyung Tribal Council

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Curyung Tribal Council
Cooperating Agency Technical Comments on
the Pebble Project (POA-2017-00271)

Preliminary Final EIS

Curyung Tribal Council's comments on cooperating agency meeting notes for meetings held on March 9-11, 2020

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Project Name: Pebble Project EIS	١.
Date: March 9, 2020	ĺ
Time: 8:30am-3pm	
Location: The Megan Room, 6591 A Street, Anchorage	
Subject: Cooperating Agency Technical Meetings, Day 1	
Introduction: Safety, housekeeping, opening remarks	

Attendees and Affiliation:	
AECOM and subcontractors	Bill Craig, Elizabeth Bella, Jessica Evans, Allison Payne, Dan Delaney, Sasha Forland, Wes Cornelison, Nancy Darigo, Cara Wright, Lindsey Flagstad, Arika Mercer, Tara Bellion, James Dietzmann
ACHP	No attendees
BSEE	John McCall
Curyung Tribal Council	Courtenay Carty, Peter Van Tuyn, Gayla Hoseth
EPA	Molly Vaughan, Matt LaCroix, Betsy McCracken, Cindi Godsey, Palmer Hough, Patty McGrath, Amy Jensen, Michael Kravitz, Joe Ebersole
LPB (Jade North)	Bob Loeffler
Nondalton Tribal Council (represented by NARF)	Megan Condon, Bruno Ridolfi, Wes Furlong
NPS	Buck Mangipane, Brooke Merrill, Kerensa King, Sharon Kim, Paul Berger
State of Alaska (SoA)	Kyle Moselle, Ron Benkert, Lee McKinley, Lee Borden, Gary Mendivil, Josh Brekken, Ed Weiss
USACE	Shane McCoy, Katie McCafferty, Sheila Newman, Heather Markway, Bryan Herczeg, Melanie Collyer
USCG	David Seris, Jim Moore
USFWS	Douglass Cooper
PHMSA	Robert Guisinger

Action Items	
Topic	Actions
General	USACE to send summary of changes from DEIS to PFEIS to CAs (done via email in the morning).
Wetlands/Water Quality	AECOM to look at the characterization of climate change trends between Sections 3.16 and 3.22.
Wetlands	AECOM to discuss with USACE about how to characterize wetlands impacts from groundwater drawdown in the cumulative effects expansion scenario.
Fish	AECOM to clarify the use of different fish stream datasets in the document.
Fish/Wetlands	AECOM will look at the baseline data for riffle and pools and use consistently through sections or give explanation of why consistent data were not used.
Wetlands	AECOM will review the discussion of intensity/magnitude in context in the wetlands section.
Fish	AECOM will look at the discussions of the four factors in the fish section to make sure the appropriate language is used.
Wetlands	AECOM will check the language in the wetlands section and make sure it is clear how the impacts were determined.
Wetlands	AECOM will carefully consider the language used in wetlands fragmentation; clearly define and clarify methods.
Wetlands	EPA will provide references about wetlands fragmentation.
Vegetation/Wetlands	AECOM will check language about fugitive dust to make sure methods are explained accurately.

Commented [Curyung1]:
Curyung Tribal Council submits these comments and redlines on the March 9, 2020 Technical Meeting Notes, based on our recollection and our notes from the meeting.

Commented [Curyung2]:

Curryung notes that these "action items" reflect only AECOM's take on what should be done. As discussed in the technical meetings, the expert agencies, including Curryung, requested other actions before the release of a Final EIS. These other actions are addressed elsewhere in this comment package.

	Vegetation/Wetlands NPS will provide references about dust deposition at Red Dog.	
Wetlands AECOM to consider how to discuss nutrient (or of		AECOM to consider how to discuss nutrient (or other parameter) changes in terms of
		water quality and how it may affect downstream wetlands and/or aquatic habitat.

Additional Notes

Project Alternatives, Process

- The USACE gave opening remarks, explaining the purpose of the meeting, which is to provide dialog to inform Cooperating Agency comments on the PFEIS.
- The USACE gave a brief description of the Applicant's Preferred Alternative and the other 3 action alternatives discussed in the PFEIS.
- The USACE will not have a preferred alternative in the FEIS, but there will be a Least Environmentally Damaging Practicable Alternative (LEDPA) identified in the Record of Decision (ROD).
- The USACE gave a brief overview of the EIS process. The PFEIS was sent out to Cooperating Agencies
 for review and comment, and 38 tribes (which is not required by NEPA).
- The USACE summarized the roles of the three federal agencies that will use the Joint ROD as a decision document (USACE, USCG, and BSEE). Curyung Tribal Council (Curyung) noted that USCG and BSEE were not in the room (note: USCG was on the phone, and BSEE joined later that morning).
- The LPB asked about the practicability of Alternatives 2 and 3 since there <u>are is no landowner</u> agreements. The USACE responded that NEPA works under a different framework than the LEDPA and so those alternatives are still analyzed in the PFEIS <u>stating that dealing with property owner issues "will come later"</u>
- ADNR requested to go over the changes from the DEIS to the PFEIS to be able to focus review. USACE
 agreed to send overview of changes to CAs. AECOM also pointed reviewers to the list of changes in the
 Executive Summary and Chapter 5.
- ADEC noted that they couldn't find changes in the document corresponding to their comments in the
 Comment Analysis Report (CAR, Appendix D of the document and the USACE comment response
 spreadsheet), and stated that some changes from the DEIS to the PFEIS that ADEC thought that USACE
 was going to do don't appear to have been made.
- USACE noted that CAs can find changes from DEIS to PFEIS summarized in the PFEIS and asked that
 CAs re-send the issues the CAs think USACE missed.
- Curyung noted that the Corps has not provided thirty days is not sufficient time to review the PFEIS for changes. It would have been good to get a red-lined version to see changes easier.
- Curyung is concerned that PLP submitted project changes without public input. Changes to the project since the DEIS are large and meaningful, and you should do another public review of the draft EIS. The USACE responded that the process is iterative, and if the changes reduce impacts they don't typically solicit comment. Curyung said that the stream impacts increased. AECOM responded that that was a factor of more refined data quality.
- EPA: We will participate as best we can given the time allowed. We see multiple challenges given the substantial project changes and the PFEIS analysis. As one example, there is not a consistent representation of resources throughout the PFEIS, which is confusing.
- The USACE clarified that the FEIS will be released in mid-2020 and the ROD will be signed at least 30 days after the FEIS.

General Topics

- Sampling frequencies/sampling extent: EPA had questions about the quality of the sampling data and the ability to make decisions based on it. Specific discussion on fish and water quality would be under the fish discussion on Tuesday and Wednesday.
- Uncertainties: EPA noted that having more information (like on stream quality data) would help reduce
 uncertainties. There are several years of data with varying spatial extents. There could be more
 discussion about that in the sections to help reviewers understand exactly what and how was analyzed.
 AECOM responded that some data has been moved to appendices. Asked for specific to determine the
 best way to address this concern.

Commented [Curyung3]:

Curyung notes that the poor presentation of changes to the PFEIS from the DEIS makes review impossible. Appendix D, containing the response to comments, fails to include information about the source of each statement of concern. Curyung's name does not appear once in the PFEIS Appendix D, leading us to believe that none of the Tribe's comments have been addressed in the PFEIS. Curyung suggests specific changes to Appendix D in our technical comments attached in this package.

Commented [Curyung4]:

This is one example of a non-sequitur response to a cooperating agency comment; the fact is that even under the Corps' artificially and in our view improperly limited scope of impact review, the impacts to streams, for example, increased by ~25% between the Draft EIS and the PFEIS.

- Standard stream network data: USACE noted that there was an effort to make the stream figures not too
 busy and asked specifically what could be done better. EPA expressed concern that there was not a
 standard stream network that was applied to all figures. Some reviewers were worried that if data were
 not shown in a figure that it might not be considered in the analysis. If different datasets were used for
 different resources, the request by EPA was to explain why.
- Monitoring plans: The ADF&G noted that a lot of monitoring takes place in the state process and not the federal process, but it would be nice to have something from the applicant that says what they are planning to do, ADF&G noted that the concept-level approach from PLP doesn't give the CAs much to go on and "highly recommend" more detail on monitoring plans. USACE added that the level of information needed for the federal process is very different that what is needed for the state process. The reminded everyone that there will be a rigorous state permitting process where there will be more detailed information. The further away from federal authority, the less information USACE requires for NEPA. Curyung repeated its objection to this limited scope of impact review.
- EPA asked if the USACE will require monitoring in the 404 process. USACE responded it will be in factual
 determinations in the special conditions in the LEDPA and the process hasn't gotten there yet.
- ADF&G recommends that the USACE informs the State as soon as they know what they will require for
 monitoring. USACE said there is a lot of monitoring required for compensatory mitigation, but things like
 wildlife monitoring are further away from authorities but are committed to by applicant.
- ADF&G noted that there is a perception that the analysis for the three action alternatives wasn't as good
 as it was for the <u>Applicant's Proposed Alternative (APA)</u>. For instance impacts to Amakdedori are detailed
 but not Diamond Point. That is problematic because it is hard to make comparisons. <u>ADF&G noted that
 the lack of detail makes it hard to compare alternatives.</u>
- Curyung pointed out that the beneficial impacts in the EIS are well-laid out but not the adverse effects, and that can show a skewed analysis.
- Curyung asked about the National Historic Preservation Act Section 106 process and if that information
 will be used in the EIS. USACE responded that they are parallel processes, but the Section 106
 information will inform some of the EIS analyses. The Programmatic Agreement will be an appendix to the
 EEIC
- Curyung questioned the analysis focusing on the project footprint. There will be big impacts downstream, especially if there is a spill. The USACE responded that the analysis considers the footprint of the project, because that is where the federal authority is. <u>Curyung repeated its objection to this limited scope of impact review.</u>
- Curyung brought up that the discussion keeps referencing 'the reader' but the document is being written
 for decision makers, and so it should be focused on adding the information they need, not the public.

Climate Change

- AECOM summarized the ways that climate change is addressed in document in three ways 1) effects of
 climate change on project infrastructure, 2) project-related greenhouse gas emissions, and 3) effects of
 climate change on the environment. That is lined out in Sections 3.1 (analysis framework) and 4.1
 (section by section summary of how climate change was discussed). Each resource topic addressed
 climate change in individual sections as appropriate.
- EPA noted that the climate change discussions didn't seem to match across the resources. Specifically 3.16 said there were no trends in precipitation, but then in wetlands section it does talk about that trend. AECOM said they would review characterization of climate change trends in these two sections.
- Additional discussion with SMEs to take place in subsequent meeting dates by specific topic.

Alternatives

USACE said there was a request that about vessel routes to and from Amakdedori be included in the EIS.
 USACE notes that they have asked for that information and it was received in RFI 163. It will be included in the FEIS. It also shows general vessel traffic for baseline.

Expansion Scenario

- There was a question Alaska <u>DNR</u> asked about if there would be other USACE reviews if the mine
 expands and how will <u>NEPA</u> work with that. USACE said yes, if there are additional impacts to waters of
 the US and navigable waters, there would be a new permit process. <u>USACE said expansion scenario is
 part of cumulative effects discussion and as such it will not inform our choice of LEDPA or the Public
 Interest Review. AECOM added that that is stated in section 4.1.
 </u>
- ADF&G noted that if the mine is expanded there would be duplicate facilities and asked how that is
 considered in the USACE decisions. USACE responded that they still have to go through the evaluation
 process and the LEDPA. If the applicant does expand, they will submit new application. The cumulative
 effects analysis is not considered when looking at the LEDPA, only the action alternatives.
- EPA asked about the pipeline under the expanded mine scenario. USACE responded that the natural gas pipeline would be in the same place but under the road there would be a concentrate pipeline.
- EPA asked if dewatering was considered in Section 4.24 under cumulative effects. AECOM said it is in there, maybe even a figure in 4.17 or K4.17. In the wetlands section they quantified the dewatering for the alternatives, but not the cumulative impact. That is because there is no project-specific wetlands data for that area. AECOM will discuss with the USACE and consider quantifying drawdown effects on wetlands in the expansion scenario. EPA brought up that consistent data sets throughout the document would be helpful, if some sections are using NWI and others use something higher quality. If different data are used it should be explained.

Wetlands

- Methodologies: EPA noted that there is no explanation of what stream network was used to analyze wetlands and fish, and so there is no way to tell if better data could be used or if all streams were accounted for. AECOM responded that the data used was more accurate than the NHD data and is a derived product from wetlands mapping with consistent acreage. EPA followed up saying that that additional discussion should be in the document or pointing to the appendix where it is discussed. AECOM responded that are different data sets. For example, for fish the data streams use data from observations. EPA added that they should identify streams that were not sampled and explain why. AECOM agreed to look into that clarification.
- Qualitative functional analysis. EPA stated that there does not appear to be a true functional assessment of wetlands, including their functions and values and which wetlands are regionally important and why. Where is discussion of site-specific information to back up the use of regionally important label on wetlands? AECOM feels this has been incorporated in 3.22 and 4.22. EPA said they would like to see more information presented in terms of how those choices were made; why those functions. In particular at the mine site, there was functional data collected. There was no discussion of why site-specific data were not used. AECOM responded that there is no reference dataset available for this area. They used NRCS functions because it presented a standardized treatment. EPA suggested using the site-specific data, and explain what was used better.
- EPA asked about the regionally important wetlands data, and how it was decided what wetlands were determined regionally important. AECOM responded that it was a synthesis based on comments received from scoping, then they developed a framework for analysis. It is also meant to accommodate special aquatic sites. EPA questioned how that framework was developed and the interpretation. They recommend the document explain what is important, what is more important, and why. AECOM stated that the "regionally important" label does not mean other wetlands are not important too. EPA questioned the use of this label and stated that some wetlands are culturally important also, i.e., due to plants, and the PFEIS does not address that.
- Curyung clarified that all wetlands are important to them. <u>Traditional Ecological Knowledge tells us that wetlands are part of the interconnected whole Everything is connected.</u> Any disruption has a significant impact. <u>Disruption of some impacts the whole and this doesn't seem to be adequately acknowledged in the PFEIS.</u> When asked where they go to traditionally harvest, they will not be forthcoming with that

information because, this is not information to share with state and federal agencies Curyung noted, local people are hesistant to share traditional harvest information in general. When being asked (through research means such as TEK interviews and ethnographic methodologies), folks have hard time providing details to anthropologists and federal agencies and project proponents. Culturally, you are humble and do not boast. From a resource security standpoint you do not share your stockpile with those not in your survival group. In addition, research fatigue is prevalent and frustrating to describe something as important as way of life. The EIS basically talks about the use of the landscape over the last few decades of data, but our people have been here for a millennia and the EIS process minimizes that.—They ask that the group is careful when making statements about what is important to the people in the region.

- Culturally important plants: EPA asked about the possibility to attribute wetlands with culturally important
 plants from known vegetation data (what plants grow in what wetlands); same comment with riffle pools.
 EPA discussed how this can't be determined with stream data, but could possibly be determined with
 wetlands data. AECOM noted that the riffle pools were not determined because the data do not exist for
 that area. Such inclusion of information would be very high level, so would not necessary be accurate
 enough to include in a table. AECOM will think about how to clarify the discussion in wetlands and fish
 regarding riffle pools.
- Severity and magnitude: EPA had a question about how the magnitude is discussed in the PFEIS; in the case of wetlands and dewatering they believe it is not discussed adequately. PEEIS has confusing discussion on wetlands impacts. Duration and permanence of impact are addressed, but magnitude and intensity are not. This means that conclusion that there will be no impact to fish without this depth isn't well supported. There was inadequate identification of what the results of the assessment of magnitude was, and there are no conclusions. AECOM responded that the framework is described in Section 4.1 and each resource applied the four factors of analysis in a NEPA context. There are no conclusion categories. The data is presented in each section and quantified to the extent possible. The magnitude/intensity are often presented as acres for a wetland resource The context of those data is in the description of what magnitude/intensity means for that resource. For wetlands, the magnitude is summarized by acres. EPA added that the final line is not drawn; EPA described that some sections explain the four factors better than others. For example, the fish sections includes more specific language; EPA provided an example and asked if this statement was conclusory rather than an assessment of impacts. AECOM will look at language in the wetlands section for magnitude/intensity, and at the four factors assessments in the fish section. AECOM noted that task is to focus on impacts from placement of fill material into waters of the US, so our primary focus is on that aspect of impacts and less the farther away you get from that,
- Curyung: That scope is too limited as it misses so many impacts. If you insist on sticking with it, you
 must acknowledge the limitations you cannot then opine on overall impacts to fish as you did in PEEIS,
 but only on the impact of fill on fish. These are far different things and you need to be very clear that your
 limited scope does not allow you to come to conclusions about impact of Pebble on fish in an overall
 sense. AECOM. Fair points. We will be clear what we are saying and what we are not saying.
- EPA asked if dewatering is a direct or indirect impact. AECOM responded that it is direct. EPA asked about the drawdown of 3 feet, and why that is not discussed. AECOM responded that it has to do with the sensitivity of the model. Drawdowns in those small changes (three feet) are not picked up in the model. With seasonal fluctuations, this is appropriate. EPA noted that if the drawdown is going to be maintained at 3 feet, that could result in a loss of wetlands function, not just a diminishment. AECOM clarified that the impacts were determined by the type of wetland, not the drawdown. AECOM will check the language in the wetlands section and make sure it is clear how the impacts were determined. AECOM added that the groundwater model information is discussed in RFI 109o.
- Fragmentation: AECOM noted the method developed, and what are not being considered fragmented in the PFEIS. EPA noted that it would be helpful to have a better definition of fragmentation and how it is discussed and analyzed. Hydrologic connectivity is only one element of fragmentation so if that is all that is used it should be clarified. USACE noted that they tried to stay as quantifiable as possible, and stay within authority. EPA said they can point to some literature on ways fragmentation is addressed, but there is a lot of literature out there about fragmentation from roads. It's not clear if those wetlands would be

considered fragmented in this analysis. AECOM will review language in the wetlands section to be specific about what fragmentation definition and analysis means in this EIS, and will include language about other fragmentation definitions from EPA literature and be clear that this document does not include expanded/other definitions.

Fugitive Dust

- AECOM gave a brief overview of the analysis of fugitive dust as it applies to wetlands, highlighting that
 the model is based on projected depositional rates and utilizes a 330 ft buffer around the project footprint
 was utilized for assessing impacts to wetlands. Indicated the dust deposition model suggest that there is
 limited amounts of dust deposited outside of the 330 ft buffer and does not justify expanding the boundary
 past 330 ft.
- EPA suggested that the 330 ft boundary may not align with the air dispersion model which should be incorporated into the wetlands analysis. EPA stated the 330 impact assumption may not reflect actual conditions on the ground. EPA suggested that the dust impact analysis area should be informed by the dispersion model and expanded as needed, referencing Red Dog Mine as an example of reaching areas far from the Mine Site. NPS stated that impacts could go on for much longer duration and scope than analyzed, especially to moss, lichens, caribou, groundwater leaching, etc. EPA agrees with NPS.
- AECOM notes that Red Dog Mine had an issue with concentrate dust shipped in open containers (the
 applicant is not proposing open containers; this practice was discontinued at Red Dog) and is not a good
 proxy. AECOM also notes that this issue has been carefully reviewed and is informed by the best
 available science which suggest that the 330 ft buffer is adequate, incorporating literature previously
 provided by CAs.
- Curyung asked for clarification regarding whether impacts related to fugitive dust are being deferred to
 the state permits or under USACE authority and suggested that this distinction be made very clear in the
 EIS. The USACE clarified that dust is considered a secondary indirect impact but state permitting will
 require more detailed and specific information to look at the issue.
- EPA suggested that the dust analysis should include a quantification of the amount of road dust generated and NPS expressed concerns regarding the impact of metals in dust deposited resulting in impacts to other resources, such as groundwater.
- AECOM clarified that dust dispersion modeling, including the mass of dust, was performed for the mine
 site and incorporated into the analysis of the EIS across several sections. AECOM also indicated that the
 330 ft buffer was applied for wetland analysis only and that impacts to other resources, such as water and
 soil, were examined based off the dispersion model and not limited to a buffer.

Water Chemistry and Wetlands

- NPS raised concerns that direct discharges of effluent water into streams may result in large impacts to
 wetlands suggesting that changes in water chemistry (various parameters) as a result of effluent
 discharge would adversely impact wetlands.
- AECOM indicated that the EIS examines impacts to water quality and hydrology and that it is not clear
 how effluent discharge would impact wetlands. AECOM notes that all discharge would be expected to
 meet the applicable state water quality criteria prior to discharge.
- EPA clarifies that although effluent may meet water quality criteria, alterations of water chemistry could still result in impacts to wetlands. According to EPA, the question is whether the project alters pre-project conditions on the landscape, and how it does so. There is no analysis of this in PFEIS. Would discharge be re-mineralized to match receiving water for example? EPA suggest that they have seen analysis of water chemistry alterations handled in different ways in different EISs and notes that this discussion could be held during water quality portion of the technical meetings. EPA also asked what are the downstream impacts of hebital degradation? How many miles downstream are impacted by loss of subsidies from upstream habitat that no longer serves all or part of its function? AECOM: See 4.24, but that is not quantified. EPA. You address indirect impacts from water, dust and fragmentation, but not habitat degradation from loss of headwater subsidies. AECOM: We will see what we can do to tie the models.

together

- NPS noted that they were not able to find information that quantifies how much downstream habitat would
 be degraded as a result of nutrient deficiencies in effluent discharged into the headwaters of stream
 habitat. NPS stated that the PFEIS also needs to address chemical mixture; the PFEIS cannot conclude
 no impact to human health without doing that. This is a dust and discharge issue for example.
- EPA said that if flow modeling examined flow contributions, it seems that it should be possible to model nutrient levels.
- AECOM indicated that this is something they will review. Additional discussion may take place under Water Quality topics on Tuesday.

TECHNICAL MEETING NOTES DAY 2 – MARCH 2020

DRAFT FOR DISCUSSION

Project Name: Pebble Project EIS
Date: March 10, 2020
Time: 8:30am-5pm
Location: The Megan Room, 6591 A Street, Anchorage
Subject: Cooperating Agency Technical Meetings, Day 2
Introduction: Safety, housekeeping, opening remarks, ground rules

Attendees and Affiliation:	
AECOM and subcontractors	Bill Craig, Elizabeth Bella, Jim Munter, Jessica Evans, Allison Payne, Dan Delaney, Sasha Forland, Wes Cornelison, Nancy Darigo, Cara Wright, Arika Mercer, Tara Bellion, James Dietzmann, Mike Gray, Richard Henry, Sagar Thakali, Tom Damiana
ACHP	No attendees
BSEE	John McCall
Curyung Tribal Council	Courtenay Carty, Peter Van Tuyn, Gayla Hoseth
EPA	Molly Vaughan, Matt LaCroix, Betsy McCracken, Cindi Godsey, Patty McGrath, Amy Jensen, Michael Kravitz, Chris Eckley, Barbara Butler, Jay McAlpine, Karl Pepple
LPB (Jade North)	Bob Loeffler
Nondalton Tribal Council (represented by NARF)	Bruno Ridolfi, Wes Furlong
NPS	Kerensa King, Sharon Kim, Paul Berger, Krista Bartz, Brooke Merrill
State of Alaska (SoA)	Ron Benkert, Lee McKinley, Lee Borden, Gary Mendivil, Josh Brekken, Ed Weiss, John Clarke, Cathe Heroy
USACE	Shane McCoy, Katie McCafferty, Sheila Newman, Heather Markway, Bryan Herczeg, Melanie Collyer, Ashley Kraetsch
USCG	David Seris, Jim Moore
USFWS	Douglass Cooper, Angela Matz, Catherine Yeargin, Veronica Varela
PHMSA	Robert Guisinger

Action Items	
Topic	Actions
	AECOM to re-examine the language pertaining to the PDO and make sure it is clear.
	AECOM to examine the 95th percentile and compare it to first flush data and to review the temperature corrections in geochemical source data and if needed, update the
	uncertainty discussion.
	AECOM to add more discussion of chemistry of toxicity testing sample test waters to text.
	AECOM will update Table 4.15-1 to clarify that dam safety factors are preliminary.
	AECOM to review language in the dust section of the EIS for clarity.
	AECOM to add discussion of methylmercury to spills section.

Additional Notes

Surface Water

NPS questioned the discussion of Pacific Decadal Oscillation (PDO), as it is not supported in recent
literature, and recommended use of other models and to look at more recent literature. AECOM
acknowledged they have seen the recent literature NPS cites, but noted that PDO is established science,
and is not a model. AECOM will re-examine EIS language to make it clear that when PDO is mentioned,
data is from other sources/models, not from PDO itself (action item).

Groundwater

• NPS recommended including further information on monitoring plan for groundwater cone of depression.

Commented [Curyung1]:

Curyung Tribal Council submits these comments and redlines on the March 10, 2020 Technical Meeting Notes, based on our recollection and our notes from the meeting.

Commented [Curyung2]:

Curyung notes that these "action items" reflect only AECOM's take on what should be done. As discussed in the technical meetings, the expert agencies, including Curyung, requested other actions before the release of a Final EIs. These other actions are addressed elsewhere in this comment package.

AECOM gave overview of the issue and the Applicant's plan, informed the CAs that it is only conceptual-<u>level at this point,</u> and noted that details of monitoring program would be worked out with DNR. <u>DEC</u> asked if there is an enforcement mechanism in place in such plans? DNR notes that enforcement is not that strong and that USACE enforcement through its permit is much better. AECOM noted that Alaska has enforcement through the Water Use Act. Curyung stated that deferral of details of monitoring plan is inappropriate because it implies that details of groundwater are not important. AECOM noted that monitoring plans would be developed once the area is dewatered, as the reality of groundwater flow will not be completely known until the area is dewatered. Lake and Penninsula Penninsula Borough noted that it's like an adaptive management plan, the details would be worked out as the project is developed. FWS suggested providing examples of other monitoring plans, or if there are no examples, then provide hypothesized examples. EPA stated they had concerns about the lack of detail for monitoring plans, noted that conceptual plans are challenging to base review on, and asked that as much information as possible be included in the EIS. EPA noted that it is not uncommon to have conceptual plans only, but it's helpful to have as much detail as possible, and that the EIS should note regulatory authority for the plans. Curyung expressed concerns about whether this could be achieved, stating that is the project would be unprecedented in scale. Curyung stated that USACE cannot call this a robust process with so many details deferred to a leter process. For example the Alaska Dam Safety Program does not engage public at all, and there will be little opportunity for holistic review later. USACE process is supposed to be robust in that way and it is not, so please do not suggest that it is.

Water Quality

- EPA noted many uncertainties in the chemical release rates and questioned the non-conservative chemical release rates used in the water quality modeling regarding exclusion of the first flush data, noting that it could underestimate release of metals. EPA will address this issue more in written comments, but lab tests do not appear to be conservative. For example, lab tests done at 20 degree c and then the results are universally multiplied by .2 to account for colder conditions on-site. This is too general as metals won't decrease at similar rates in lower temps, and some may even increase. AECOM will compare first flush with 95th percentile values and review uncertainty discussion. EPA also noted that temperature corrections data may not be appropriate, providing specifics on laboratory methods and equations applied. AECOM will review this. EPA agrees that more discussion in the EIS would be good, but notes that EIS may need to show how uncertainties might impact conclusions. Curyung said they have the same comment as the EPA and guestioned the reliability of conclusions, and asked to please be clear about what the EIS is doing/not doing.
- EPA requested discussion of the impact of sulfate releases on downstream methylmercury production. EPA expressed several points about how this topic was addressed in the EIS. AECOM noted that they will review the EPA comments on methyl mercury. Later in the meeting NPS brought this up again, and asked, regarding levels of dissolved oxygen, if any of the samples were from wetlands, as that is prime area for anoxic conditions. NPS noted there are data gaps in sampling locations given PLP's alternative. See 3.18, with 2005 and 2007 data on a route that is no longer PLP's approach. AECOM to review, but does not anticipate further field work.
- USFWS noted that there was no mention of potential increase in mercury methylation in the spills section.
 AECOM to address this in the spills section (action item).
- EPA questioned the representativeness of samples used for toxicity testing as a basis for predicting
 impacts of concentrate, tailings, and process water spills in the spills chapter. EPA: please include
 rationales as to why toxicity tests are representative of the bigger picture, as we think that may not be the
 case. AECOM will add more discussion of uncertainty to the text.
- EPA commented on the exclusion of erosional processes on the impacts of fugitive dust on water quality, noting that a lake was used as a surrogate for a stream system, and that the mobility of dust could be underestimated. AECOM noted that a conservative approach was taken. AECOM will review language in the dust section for clarity.

2.

- EPA mentioned evaluating potential interactions among stressors related to the mine (e.g., considering how flow changes will affect sedimentation). AECOM and EPA agreed to postpone discussion until Wednesday under the fish topics.
- NPS noted that they will recommend in their formal comments clarifications or further summary of sources
 in order to make the field studies and analysis more accessible to the public reader, and also
 recommended a series of minor changes to the analysis to better incorporate best available science.
 AECOM will review their specific comments on PFEIS when received.
- NPS recommended a correction to predicted increase of air temperature based on the 4th National Climate Assessment, noting that the temperature change prediction is dependent upon the particular emissions scenario, and ranged from a 3-5 degree increase. AECOM will review their comments.
- NPS noted surface water sample locations from Lake Iliamna are not within the PFEIS applicant's
 preferred alternative ferry route and recommended acknowledging this as a data gap. AECOM will
 review
- EPA asked if additional evaluations regarding water treatment are planned to occur before the FEIS or as possible mitigations to reduce uncertainties, and inquired as to level of certainty for EIS. AECOM noted that nothing else planned before FEIS. EPA noted that water treatment has not shown to be viable at the proposed Pebble scale. The EPA asked the USACE if they are comfortable moving forward with FEIS with this technical uncertainty about water treatment? USACE replied yes. EPA noted that the water pond would allow for storage up to three years to allow for changes to water treatment, and stated that EIS should evaluate whether changes would be possible within three years. USACE said to table the discussion. EPA noted that if the FEIS moves forward with uncertainties, the document should present potential consequences if the treatment is not attainable. EPA asked how USACE would address changes to the WTP approach that may come in later work? AECOM: We are comfortable moving forward despite the uncertainty. Let's table the WTP change discussion. EPA: If you are moving forward to FEIS, then review consequences if approaches in PFEIS are not attainable. Fish and Game ADF&G asked if water is stored for three years while PLP makes changes to its WTP, how to supply missing streamflow input for those three years? AECOM: no answer.
- EPA noted that there could be a potential gap regarding groundwater model parameters. AECOM noted that groundwater/surface water interactions were considered.
- EPA asked about habitat conditioning from effluent from water treatment; temperature and dissolved oxygen are considered, also consider ion concentration? AECOM to consider adding as mitigation.
- EPA noted that they will have more comments on water topics to come; still a concern with water treatment; EPA may want another meeting.
- Curyung noted that they appreciate the changes from DEIS to PFEIS and that new models are complex and they need more time to allow experts to review; they are very uncomfortable with water treatment uncertainty which would be one of the reasons for revised/supplemental EIS; new numbers in water balance have increased from the DEIS and leads to higher risk; unprecedented volumes of water to treat; environment so critically connected to that water volume; don't understand lack of detail with respect to the uncertainties, the EIS should better explain the uncertainties and risks; expanded development scenario would be 53 million gallons/day; that PLP has not committed to not using cyanide under the expanded mine scenario is another red flag; they have serious concerns; EIS should be clear about limitations; tribe has to live with consequences of uncertainty.

Air quality

- EPA felt that there are still some incorrect emission factors. AECOM to review.
- EPA mentioned the proposal for the ambient air boundary and recommended additional documentation.

They noted the application would have a proposal for boundary and they suggest including the proposal in an appendix. EPA also noted that the proposed boundary would have to follow new EPA regs_and_should be clearly identified. AECOM noted that the air boundary would be determined by the state. AECOM to review.

- EPA discussed NO2 impacts at the Dimond Point Port site alternative, stating that the analysis provided
 in the PFEIS shows possibility of impacts at Dimond Point port alternative potentially above standards.
 EPA noted that the use of a conservative model alleviates some concern; EPA suggests modeling
 Diamond Point port where there is data. AECOM to discuss.
- EPA had questions about a source cited for aircraft emissions. AECOM noted that the source is specific
 to tiered engines and is commonly used in NEPA.

Spills

- USFWS raised concerns that there was no discussion of the potential for Mercury Methylation in the spills section of the PFEIS. AECOM indicated that this discussion could be added.
- EPA raised concerns regarding the representativeness of water samples used for toxicity testing as a basis for predicting impacts in spill scenarios. EPA noted that the sample appears to be based off the non-gold tailings and would like additional rationale for the use of this water sample. AECOM indicated that the laboratory sample was from non-gold plant tailings and was meant to represent worst case scenario therefore was a conservative spill scenario proxy sample. EPA indicated that they believe the spills section should include text describing the samples.
- ADNR indicated that they had questions and concerns pertaining pipeline freezing protection and would be submitting more comments formally. AECOM noted where information pertaining to pipeline freeze protection (burial) is located in the EIS.
- NPS recommended inclusion of information pertaining to species and biological community assessment
 areas located downstream of the Lower Cook Inlet for the affected environment analysis for spills.
 AECOM requested further information and clarification from NPS regarding species for inclusion. NPS
 indicated that their experts would send information to AECOM for review.
- NPS expressed that a mass balance analysis should be incorporated into the EIS. AECOM clarified that
 mass balance was examined and is discussed in section 4.18 of the EIS. NPS also noted concerns
 regarding environmental consequences following multiple stressors in the spills section and suggested
 that there are additional references they could provide pertaining to impacts on coastal regions.

Tailings Dam Stability and Failure

- EPA asked for clarification on discussions of factors of safety in K4.27 vs K4.15, and whether statements
 pertaining to the factor of safety in the EIS were still accurate. AECOM clarified that in sections 4.15 and
 K4.15 that safety factors are presented for specific conditions and based on conceptual design only.
 AECOM indicated that statements in the EIS pertaining to the factor of safety are accurate and include
 discussions of uncertainty as applicable. EPA noted AECOM may consider editing table 4.15-1 to clarify
 that factors of safety are preliminary, AECOM agrees.
- AECOM reviewed an EPA comment pertaining to additional studies and information regarding the tailings dam design and whether there are design changes that could reduce uncertainties. AECOM indicates that no additional studies are planned prior to release of the FEIS but studies would happen at a later time for State of Alaska dam permitting. AECOM noted that design changes would likely be minor changes that would be developed as more information becomes available, noting that this iterative process is a standard industry approach to dam design. EPA noted concerns regarding tailings uncertainties such as whether tailings segregate as expected. AECOM noted that the design engineers suggest that tailings should segregate and that bench scale testing would test the segregation abilities as part of final design/State of Alaska dam permitting. EPA suggest that it may be wise to consider cycloning of tailings into the analysis. AECOM indicates they will consider it. EPA asked if USACE can require bench testing to confirm the tailings segregation. AECOM: Bench testing can be done and will be

done in the future. EPA: There is significant uncertainty here, and that uncertainty should be elevated in the NEPA analysis. AECOM: That does not mean that we need to do a full breach analysis as it is so unlikely.

- Curyung noted uncertainty pertaining to the stability of the tailings dam and the safety of the dam.
 Curyung indicated that they are uncomfortable with the level of uncertainty pertaining to dam stability and the analysis of potential failures. USACE clarified that dam failure scenarios were analyzed, but not worst case scenario failures that require lengthy causal chains. Curyung notes lack of confidence in dam design, citing an AECOM tech memo (AECOM 2019n) which highlighted concerns of and raised the possibility of embankment failure. AECOM: Very unlikely to happen. Additional design work will be done. We are comfortable with our approach.
- AECOM addressed a question from the EPA as to whether additional information on TSF design would impact the conclusions of the Failure Modes Effects Analysis (FMEA) workshop held in October 2018. EPA cited the ACEOM 2019n memo that says tailings may fail and noted that a full failure analysis is a good idea given the concept-level design and uncertainties around segregation. EPA elaborated that the comment pertains to remaining uncertainty and suggested that failure scenarios for the bulk TSF should be analyzed. AECOM indicated that FMEA workshop analysis was based on the available conceptual design and that expansion of preliminary work would likely not change the conclusions of the FMEA. EPA raised questions regarding why the FMEA did not include assignment of confidence levels to the risk ratings. AECOM noted that confidence levels were not addressed for individual failure modes in the FMEA due to the conceptual nature of the design. AECOM also noted that the FMEA was an EIS-Phase FMEA and was not intended to be a full risk assessment as would be required by the State dam safety program.
- Curyung raised additional concerns regarding dam safety and suggested that USACE should require more than just a conceptual design, noting that the analysis and design is not a robust approach to addressing and analyzing the risks. Curyung raised further concerns regarding uncertainties in the dam design. AECOM clarified that the uncertainty pertains to detailed aspects of dam design, not the design itself, and that uncertainty would continue to be reduced as design advances. There was discussion across the room as to when it is typical for dam design to be evaluated in more detail. USACE noted that they do not require the same level of detailed dam design as the State of Alaska, as dam safety is not under the Corps authority, but rather that of the State.
- EPA stated it remains concerned with the lack of a failure analysis and their concern is compounded by the fact that the FMEA did not include confidence levels. EPA again asked about the lack of confidence levels in the FMEA and asks AECOM to address FMEA confidence levels. AECOM noted that confidence levels are addressed in the FMEA final report. EPA suggested that it sounds like there are low confidence levels and the analysis should go a step further, however AECOM indicated that this would be part of the dam safety review and not necessary for the EIS. Lake and Peninsula Borough asked why not at least identify some of the problems here?
- Curyung questioned what the downside to doing full dam failure analysis would be. <u>Curyung asked what is that national interest in avoiding to do a full failure analysis in the face of so much interest in having it done from local people and experts? USACE indicated that the FMEA did not identify a mechanism for a complete catastrophic dam failure and such a failure was deemed to be extremely unlikely; also as per the USACE interpretation of NEPA guidance, they are not to analyze extremely unlikely events. Additionally, USACE noted that tailings dam safety is not within their regulatory authority. <u>Curyung asked USACE</u> to show a similar dam to Pebble that has worked. AECOM and USACE, no response, EPA asked if someone from the Alaska Dam Safety Program (ADSP) was available to answer some of these questions. Lake and Peninsula said should check with ADSP on this. FWS; agreed with these concerns and stated that when there are conflicting conclusions between the body of the PFEIS and the record documents, the public confidence in the analysis is undercut.</u>

Oil and Diesel Spills

PEBBLE PROJECT
ENVIRONMENTAL IMPACT STATEMENT

TECHNICAL MEETING NOTES Day 2 – March 2020

DRAFT FOR DISCUSSION

NPS expressed concerns pertaining to the analysis of spill risks from tank barges and asked why were the specific scenarios chosen. NPS indicated that data used to evaluate tank barge spills used a different type of marine vessel than would be utilized in the Pebble Project. NPS stated that under the current analysis, it is hard to get a sense of the potential impacts and evaluate the choices that can be made between alternatives. USFWS commented as to why certain volume diesel spill scenarios were selected for analysis rather than others. USFWS suggest that there needs to be a better description in the EIS regarding what spill scenarios were evaluated and what they mean. AECOM to review the information regarding tank barge spills and spill scenarios.

PEBBLE PROJECT
ENVIRONMENTAL IMPACT STATEMENT

TECHNICAL MEETING NOTES Day 3 – March 2020

DRAFT FOR DISCUSSION

Project Name: Pebble Project EIS
Date: March 11, 2020
Time: 8:30am-5pm
Location: The Megan Room, 6591 A Street, Anchorage
Subject: Cooperating Agency Technical Meetings, Day 3
Introduction: Safety, housekeeping, opening remarks, ground rules

Attendees and Affiliation:	
AECOM and subcontractors	Bill Craig, Elizabeth Bella, Jessica Evans, Allison Payne, Dan Delaney, Sasha Forland, Wes Cornelison, Nancy Darigo, Cara Wright, Arika Mercer, Jonathan King, Jim Munter, Mark Allen, James Dietzmann, Kaley Volper, Andrew Fisher
ACHP	-
BSEE	John McCall
Curyung Tribal Council	Peter Van Tuyn, Courtenay Carty
EPA	Matt LaCroix, Betsy McCracken, Mike Kravitz, Amy Jensen, Patty McGrath, Joe Ebersole, Palmer Hough, Michelle Davis, Cindi Godsey
LPB (Jade North)	Bob Loeffler
Nondalton Tribal Council (represented by NARF)	Bruno Ridolfi, Ysabel Diaz, Monty Rogers
NPS	Sharon Kim, Kerensa King, Krista Bartz, Kelsey Griffin, Brooke Merrill, Rachel Mason
State of Alaska (SoA)	Kyle Moselle, Ron Benkert, Gary Mendivil, Josh Brekken, Lee McKinley, Lee Borden, Ed Weiss, Alyssa Miller, Robin Dublin
USACE	Shane McCoy, Katie McCafferty, Sheila Newman, Heather Markway, Bryan Herczog, Brandee Ketchum, Ashley Kraetsch
USCG	David Seris
USFWS	Douglass Cooper, Catherine Yeargan, Angela Matz, Kevin Foley
PHMSA	Dave Hassell

Action Items	
Topic	Actions
Fish	AECOM to consider quantification of dust from vehicle traffic.
Fish	AECOM to review NHD and wetlands stream mapping data layers.
	Curyung to send figure showing fish distribution/portfolio effect to USACE and AECOM.
Fish	NPS to send monitoring data regarding Newhalen River salmon escapement to USACE and AECOM.
Fish	Additional AECOM SMEs will review the source Wobus et al. 2015 as per streamflow data.
Fish	AECOM to clarify discussion of multiple stressors and potential synergistic effects on fish, including uncertainties.
Fish	AECOM to incorporate 2018-2019 Bristol Bay Commercial Fisheries Data into the EIS.
Fish	AECOM to clarify discussion of modeling and verify accuracy, including disclosure of uncertainties and model limitations.
Fish	Review the analysis of water quality impacts to salmon homing abilities.
Wildlife	AECOM to add discussion of historic shorebird colonies and marine mammal haul outs farther south in Cook Inlet.
Wildlife	NPS to send reports to USACE and AECOM on historic shorebird colonies and marine mammal haul outs farther south in Cook Inlet.
Wildlife	AECOM to revisit the disclosure of impacts pertaining to brown bears.

Commented [Curyung1]:

Curyung Tribal Council submits these comments and redlines on the March 11, 2020 Technical Meeting Notes, based on our recollection and our notes from the meeting.

Commented [Curyung2]:

Curyung notes that these "action items" reflect only AECOM's take on what should be done. As discussed in the technical meetings, the expert agencies, including Curyung, requested other actions before the release of a Final EIS. These other actions are addressed elsewhere in this comment package.

Commented [Curyung3]:

This figure is found in:

Sean R. Brennan, Daniel E. Schindler, Timothy J. Cline, Timothy E. Walsworth, Greg Buck, Diego P. Fernandez. Shifting habitat mosales and fish production across river basins. Science, 2019; 364 (6442): 783 DOE 10.1126/science aav4313

Curyung has also attached this study to our comments on the Preliminary Final EIS.

Wildlife A		AECOM to review daily vehicle traffic information in the EIS.
	Wildlife	AECOM to add a description of the pipeline support berm proposed in Iliamna Lake to the EIS.
	Wildlife	AECOM to review use of Koktuli for recreation float trips.

Additional Notes

Fish passage and preservation of fish passage after mine closure

- EPA stated it does not believe PFEIS conclusions that there will be a lack of long-term fish passage problems are supported by the evidence. The 2014 Bristol Bay Watershed Assessment (BBWA) concluded that this risk is real and is based on best available information. The PFEIS underestimates the likely impact of the road overall. AECOM noted that culverts would be designed as appropriate for fish populations. EPA requested information as to who maintains roads/culverts in post closure, stating that the quality of monitoring would likely decline and lead to failed culverts; acknowledged that there is low risk of culvert failure during active operations, but that the risk of culvert failure in post closure is not accounted for and that thus the EIS underestimates risk to fish. EPA also noted that crossings are abundant and that the EIS implies impacts only during construction; minor impacts at a large number of crossings can result in cumulative impacts that are not disclosed. Lake and Pen Borough noted that other EISs such as Red Dog and Pogo do not go into detail on culverts. EPA noted that science and NEPA advances and EISs get longer, so now it is appropriate to address issues. Lake and Pen agreed.
- Curyung indicates that NEPA is requires fact specific analysis, that this issue is important and we agree
 with EPA that the conclusions are not supported in the record.; Tribes rely on salmon so it is appropriate
 to have high burden on salmon for this EIS; they are last remaining salmon-based culture in the world.
- ADFG notes that Red Dog road is state road that would be maintained, different situation with Pebble road as it is unknown as per maintenance after closure; some mitigation deemed unlikely in the EIS but the State would regulate to modern design standards so some of this mitigation is not unlikely; the State is encouraging bridges where possible.
- ADFG notes that it is best to design for fish passage even where fish are not documented; it's not that
 hard to do.
- Curyung agrees with ADEG sampling is important for many reasons, not just for fish passage. USACE cannot understand the full impacts without it, and definitely cannot support conclusions in the PFEIS that there will be no measurable impact on fish populations, as the PFEIS concludes without sampling. EPA agrees and notes that downstream impacts can be quite significant. Such as direct, secondary, and cumulative impacts that are unjustifiably minimized in the PFEIS.

Production of dust from vehicle traffic

EPA stated that the amount of dust produced would be high and an estimate of tons of dust produced per
year should be made; USFWS agrees with comment and notes that the EIS needs more discussion.
 ADFG suggested also looking at impacts of potential mitigation, such as spray used and potential runoff.
 Coast Guard notes that fugitive dust impacts from runoff from bridges should be addressed. AECOM will
consider quantification of dust from vehicle traffic.

Justification for the assumption that effects downstream of road crossings will only occur within 0.25 mi downstream

AECOM stated that this area is where anticipated extent of potential effects would be expected, not
including failures. USFWS noted that this is reasonable, but EIS need to address any new conclusions as
pertaining to dust.

Recommend including a figure indicating tributaries that would be impacted directly by mine development.

- AECOM noted that several figures in EIS show this, and asked what kind of figures are requested. NPS
 requested a single figure that shows all impacts with a clear indication of which tributaries would have
 permanent change. EPA noted that it would be valuable to have a combined network map showing where
 fish are/are not, similar to that in wetlands section. AECOM will review NHD and wetlands stream
 mapping data layers.
- AECOM noted that it has not been determined there are streams at the mine site that have not been surveyed for fish. AECOM is reviewing.
- There was additional discussion across various agencies noting the variability of fish presence in streams
 over time and the difficulty of obtaining accurate data. ADFG noted that it is best to design for fish
 passage even if the limited data doesn't reveal fish presence because at some time there may be fish.

Recommend bolstering or removing unsupported conclusion of lower quality/low use habitat.

• AECOM noted that they did not want to imply that it is low quality habitat, but lower quality compared to downstream habitat where there is abundance of fish. NPS noted that lack of fish doesn't equal poor quality habitat. EPA stated that EIS language comes across as saying habitats that would be directly impacted are of low quality; downstream habitats would also be altered by project from indirect effects; the EIS diminishes the importance of direct impacts and does a poor job of describing secondary impacts. NPS noted that cumulative effects are stated to be minor to moderate and that these impacts are not captured by cumulative effects table; cumulative effects analysis not adequate; cumulative effects impacts are just addressing past and present actions and RFFAs, but should instead address whole system. Guyung agrees that cumulative effects should not be considered minor to moderate, and that this conclusion cannot be justified with the limited scope which of USACE is applying to its review of the potential impacts of the permit application (a scope which is intentionally focused on the direct impacts of the placement of fill in waters of the U.S.).

Recommend providing information about aquatic habitat and fish along transportation corridor roads.

• AECOM noted that this topic has already been discussed and asked what else agencies are looking for. NPS stated that there is missing information on smaller streams, and asked to make sure that information at road crossings is complete. NPS stated that PFEIS section 4.2 says that cumulative effects of the Applicant's Preferred Alternative are "minor to moderate." but the chart there doesn't capture the full indirect and cumulative impacts. CuyungCuryung showed a chart that shows the challenge to documenting fish presence (illustration of portfolio effect), noting that fish presence varies by year and the difficulty of accurately characterizing fish presence on those corridors. USACE asked Curyung to provide the illustration and supporting studies. ADFG agreed with statement; biology of fish in Iliamna drainage shows that fish presence varies over time.

Recommend adding Newhalen River salmon escapement data.

 AECOM noted that additional information was added, and asked what else could be added. NPS stated they would send monitoring data.

Recommend minor corrections to analysis of fish migration.

NPS stated that they will email specific comments

Recommend that the instream flow model incorporate the projected changes to streamflow from the warming climate in this region. Sources provided.

- AECOM noted that climate variability data is included in the model in 4.16, and that the model fed habitat modeling. NPS and USEWS mentioned that the source Wobus et al. 2015 has a hydrological model for this exact site. The Wobus et al. 2015 provides for climate link to stream flow and water temperature. AECOM stated that some SMEs have reviewed that source, it is in their database, and other AECOM SMEs will review that source.
- EPA agrees and states that USACE's current models appear internally inconsistent. The models show total dewatering of streams during operations, and then doubling of streams and habitat post-closure.

Commented [Curyung4]:

Awkward sentence. ADFG, and others, including Curyung, stated that there are streams that were not surveyed, and that some surveys that were undertaken were not scientifically sound, i.e. hastily done with a methodology not likely to capture accurate fish presence and use information.

This analysis is too one-dimensional and does not reflect reality. ADFG agrees and says that what USACE/AECOM used might be a good tool, but it does not support your conclusions.

Curyung reminds USACE and the CAs not to forget about the connection of streamflow impacts to
people. What impacts the fish in turn impacts the people and the PFEIS needs to better address this.

Recommend including a comprehensive summary of impacts of the entire project to fish in the cumulative effects section.

- EPA stated that USACE needs to be very clear about what is known and not known in the PFEIS. The PFEIS says that the project is "unlikely to have measurable impacts" on fish, but there are limits to the evidence that supports this conclusion, including the severe limit in scope used by USACE, and USACE doesn't address those limitations. EPA noted a concern about synergistic interaction, and how impacts can amplify to produce secondary impacts; also requested more broad discussion of all impacts within cumulative effects as per multiple stressors issue; stated the need to combine impacts to wetlands, streams, and state potential to amplify impacts to fish. ADFG stated similar concerns as EPA. Curyung noted that if the EIS does not address cumulative sufficiently it would be impossible for decision makers to make their decision. AECOM will clarify discussion of multiple stressors and potential synergistic effects on fish, including uncertainties.
- NPS noted that EIS also needs to include discussion of discharge load; 4.18 mass loading discussion is
 insufficient. <u>CurrangCurrang</u> stated that there are 3 choices of direction when data is limited; 1 ask the
 Applicant; 2 wait for state permits; or 3 identify limitations and don't make conclusions; with the narrow
 scope and speed of process the 3rd option is the only option. EPA stated a need to justify no measurable
 impact in cumulative effects analysis, and to describe uncertainty and how it pertains to conclusions.

Recommend bolstering or removing unsupported conclusion of that habitat loss will not have an impact on fish populations downstream.

• NPS stated that the statement that habitat is lower quality is not substantiated and that the analysis does not support that statement. EPA agreed with that and asked if it would be possible to conduct additional analysis to supplement current PHABSIM model analysis, and also look at synergistic impacts. For example, EPA noted that not gain or loss is evaluated on an annual basis, which is not representative of likely impacts. And increase in water discharge does not always equal increase in fish habitat, it is more complicated than that with more variables that are relevant. The model AECOM used looks to only some project-related changes. We can continue to talk about this. AECOM asked if there were any specific other models EPA would suggest. There was discussion of the idea of conceptual models and the extensive data set that could be analyzed to reach preliminary conclusions, but no specific other models were suggested. EPA also noted that difficult NEPA topics justify using multiple approaches, and provide examples from other projects. EPA also asked if habitat changes could be based on other variables and if project related changes could be quantified, noting that conclusions were reached based on discharge and velocity alone. Curyung also encouraged the EIS to look at human impacts as well.

Recommend bolstering or removing unsupported conclusion of no impacts to incubating eggs or alevins from impacts to groundwater temperature.

AECOM noted that the fish analysis was based on the analysis of physical impacts; discharged water would meet state and federal water quality standards. NPS stated that the EIS needs evidence to support the conclusions, ie, the EIS needs data on groundwater temperature to support conclusions. EPA stated that just because water meets water quality standards does not mean there are no impacts; effluent temps do not match baseline and iemperature changes can have an effect on eggs. Ambient temperature of receiving water and groundwater is key to understanding impacts. What you are doing there is effectively a mixing zone of several miles long; there is temperature differential that would affects eggs in gravel; even though within range of variability does not support conclusion that there would be no effect. ADFG stated that the issue is not as simple as warm water makes early emergence which is good; issue needs a closer look. ADFG also noted that conclusions are not supported and that there are some contradictions; and that the Copper River study is not applicable. EPA stated that groundwater

amelioration is not applicable because groundwater supply would be cut off by project; there is a need to look at interrelationship of project changes. AECOM noted that there would still be groundwater recharge from north side and that the discharged warm water rises, and does not impact bottom of stream where eggs are. EPA questioned AECOM's conclusions that groundwater recharge would work this way and stated that the model does not support that conclusion. EPA also questioned impact on returning adults inding their way back and the impacts of temperature on returning adult salmon, noting that EIS needs to account for all life stages and the long-term. USFWS agrees with EPA and ADFG regarding the totality of impacts to be accounted for, including cumulative; notes that there are internal inconsistencies throughout document; when discussion is compartmentalized the overall consistency is sidelined; need to move broad conversation forward so a full picture of the impacts is analyzed.

Revisit the issue of incorporating the 2018-2019 Bristol Bay Commercial Fisheries Data into the EIS.

• AECOM agrees that it's time to add more recent data, and that it is simple to add and that all sections could be updated for Bristol Bay; one challenge is that the annual management report has not been published yet. ADFG noted that this has been a big issue in Bristol Bay and they will follow up regarding availability of document; it is usuality available in April. AECOM will incorporate 2018-2019 Bristol Bay Commercial Fisheries Data into the EIS. Curyung also requested that the EIS address the fact that the Nushagak hinook escapement was recently not met for first time in their memory; and also to please include most recent Muichatna caribou herd data. Curyung noted that the data in the PFEIS shows a Muichatna Caribou herd population twice what it is now and points out that this must be updated in the EIS.

Predicted habitat suitability under modified stream flows.

EPA, the acreage estimates are not accurate, ADFG; miles of water are suitable for spawning, and in the same areas where AECOM says that only a few acres are suitable. So there are mixed standards and unsupported conclusions. AECOM may request assistance from R2 to address issues where there seems to be logic issues, and regarding changes in monthly vs daily surface flows and flow time series data; this could be a potential RFI. EPA asked if the EIS can address habitat losses not accounted for in PHABSIM modeling because the model does not capture resident fish loss in mine site, also doesn't capture 6.71 miles of habitat in NFK tributary. AECOM noted that the model also considers quality of habitat. EPA stated that habitat losses that are not accounted for should be noted. AECOM will clarify discussion of the modeling and verify accuracy, including disclosure of uncertainties and model limitations. NPS noted that the focus is on streamflow, but also need to include water quality, such as temperature, metals, etc. AECOM stated that water quality has been considered. EPA; the PFEIS is not addressing concerns of offactory impacts to fish. EPA stated that EIS does not address imprinting juveniles and their ability to return to streams, noting that there would be alterations to water quality and that there is a very sensitive balance with the chemical signature of water. Curyung noted similar concerns with imprinting regarding copper levels, etc, from pyritic and bulk TSFs. ADFG agreed this needs to be addressed, as water chemistry would be changed all the way to the Bay. NPS stated that there is no mention of olfactory issues. USFWS noted that this was one example of a compartmentalization problem, noting the mixtures of contaminants and potential impacts on olfactory issues. AECOM will clarify discussion of multiple stressors and potential synergistic effects on fish, including uncertainties.

Provide additional data on cumulative impacts of environmental on marine wildlife stressors to bolster analysis of marine waters.

NPS noted that there is no acknowledgement of historic seabird and marine mammal haul outs and that this needs to be acknowledged for spills and cumulative impacts and the PFEIS needs to address water treatment impacts at the port. AECOM stated that they can add this information. NPS will provide reports to AECOM/USACE. USFWS noted lack of information regarding another water treatment plant at the port to deal with wash water, stating that no discharge information is provided in the document and that there could be impacts on benthics etc. State of Alaska agreed and noted that there were no details on water treatment for this water treatment plant.

Landscape level impacts to fish populations (portfolio effect)

- USFWS noted the importance of considering habitat impacts from multiple sources and that cumulative impacts and RFFAs could erode habitat and that this is not adequately addressed; even small impacts can have disproportionate impacts; incremental degradation can lead to impacts; additional analysis of cumulative and expanded mine scenario needed; they questioned how much development of Pebble could facilitate development of other potential mines in area; EIS focused on local scale impacts, not enough focus on expanded portfolio concept. EPA noted issue of local adaptation of fish, stating that the EIS does not support conclusions that there would be no effect on genetic diversity and that habitat is not interchangeable.
- NPS noted that the statement in 4.18 regarding mass loading having no impacts is unsubstantiated. NPS also noted statement in K4.24 is also unsubstantiated regarding mercury releases not expected to have adverse impacts; NPS noted that changes may be within water quality standards, but minor changes can still have impacts nearby lake waters have low mercury levels, yet fish have elevated mercury levels, so the document needs to consider transfer from water to biota. Curyung noted that then fish get eaten by humans, and that even if water quality criteria are met, bioaccumulation could still be an issue that is not addressed in the PPEIS. USFWS noted that there is a dismissal of selenium and mercury, and that small amounts in water can lead to bioaccumulation, and that the lack of discussion on mercury is incorrect based on scientific knowledge.

Additional Fish topics:

- ADFG noted the new mention of the berm on the bottom of Iliamna Lake to support the pipeline, and that
 there is no analysis of impacts from installing berm, or impacts if pipeline falls off berm.
- ADFG noted a misrepresentation of the Koktuli River as low volume use, but that it is actually very high
 value use based on status as float trip river. AECOM appreciated the new information.
- EPA noted new references for portfolio effect; 26 genetic reporting groups identified.
- ADFG noted that is difficult to follow the analysis, and that the analysis may have been more robust than
 presented; impacts could be broken down more in tables; more info on overwintering in particular is
 needed. AECOM to review text for clarification.
- Curyung commented on fish consumption and relevant ADEC water quality standards; they stated that
 the EIS underestimates fish consumption as the studies on which it is based are ~15-16 years old and are
 not a reflection of current consumption. USACE noted that the EIS uses the best data that is available.

Mitigation

- USACE gave an overview of the three comments received pertaining to mitigation and the draft mitigation plan for the project. USACE gave an overview of the process in decision making and the role of compensatory mitigation in the NEPA process and unique challenges pertaining to compensatory mitigation planning and the pebble project and noted that no decision regarding compensatory mitigation for the project has been made at this time. EPA expressed that mitigation, including compensatory mitigation, is included under NEPA and that they feel it should be discussed in the EIS and if not, questioned where it would be discussed. USACE indicated that a detailed discussion of compensatory mitigation will not be discussed in the main EIS but it will be discussed in the ROD. EPA expressed concern that the state of the current compensatory mitigation plan is very high level and does not include much detail. USACE noted that it would be inappropriate for them to speculate impacts for the compensatory mitigation plan as they have not yet completed the environmental analysis. EPA stated their initial reaction is that for beach cleanup and waste water proposals there is no explanation for what amount or type of loss is offset by the proposal. The CMP has a little information on outverts 8.5 miles of stream habitat opened up per CMP—but no details provided to back it up. Also, it is unclear if the CMP is focused on compensating for direct losses or all losses. USACE: it is premature to speculate on final CMP details.
- EPA questioned whether there would be a broader opportunity to get more information from the public regarding the compensatory mitigation plan. USACE indicated that there would not be, noting that this is a

unique project, however this is the typical process which they follow. Curyung questioned why not hold a public scoping event for the development of the compensatory mitigation plan. USACE noted that they are following the standard process which does not solicit input and they will not do it with this project. EPA noted that there is an avenue in which requiations allow for USACE could to require public scoping for the compensatory mitigation plan for a project of this size if they choose to. Curyung reminded USACE that it held a 30-day public comment period on the final compensatory mitigation plan for the Domlin Mine. USACE indicated that they are aware and would table this discussion until further internal discussions occur.

- Lake and Peninsula Borough raised concerns regarding the compensatory mitigation plans, highlighting concerns that the plan would allow for compensatory mitigation to take place outside of the watershed and benefit communities not impacted by project development. Elaborated that if you develop a compensatory mitigation plan based off mitigation credits in a remote area such as this, it could allow the applicant to repair road culverts or take compensatory action somewhere else that would not benefit the local population and suggest there may be a better way to handle compensatory mitigation. EPA notes that no matter what the applicant proposes to do that it must fit within the regulatory framework first and foremost, which includes a compensatory mitigation plan. Curyung suggests holding a public meeting and asking the tribes what they would like to see for compensatory mitigation. EPA indicates that a careful discussion with the tribal governments seems merited for this. USACE to consider.
- ADFG noted that there are many different types of culverts and that it would be incumbent for decision makers to carefully review culvert data for culvert replacements as necessary per mitigation. <u>ADFG noted that PLP</u> focuses on "red" category of culverts as identified by ADFG, but that this category is judged by a juvenile fish standard—if drop is ~24" juvenile salmon may not be able to get into and through the culvert. Using that "red" category, as PLP did, to identify culvert projects, and then to conclude that their plan would open up 8.5 miles of streams to salmon, is too slimplistic, and likely wrong. What does not work for juveniles may be ok for adult salmon. Also, what is the habitat that is opened up by the culvert plan? That is not clear, and can vary widely. ADFG elaborated that placing a certain type of culvert in one location could have benefit, so as mitigation moves forward ADFG encourages that a close look be taken at culverts. USACE to consider.
- EPA indicated that an assessment of effectiveness for mitigation measures should be added to Table 5-2 which
 includes proposed mitigation measures. EPA understands that many of which are BMPs, however they feel it
 would be useful to include. USACE to consider.
- Curyung notes that USACE should consider the full context of uncertainties regarding the full impacts when
 developing the compensatory mitigation plan. Noting that if the full impacts are uncertain, it is difficult to
 properly target compensatory mitigation. Curyung noted that this is a cross-cutting issue and is not just about
 appropriateness of the CMP. The EIS must accurately identify impacts to fish habitat as a precursor to
 adequate CMP, yet as discussion over these days has shown, those impacts are not accurately identified in
 PPEIS. Corps should do new Draft EIS to lix this, and bring in CMP through that for public review and input as
 well. This would allow for a holistic look, while current approach does not.

Wildlife

- AECOM begins reviewing comment pertaining to sea otters and request for clarity from NPS. NPS indicates
 that the comment was specifically related to a lack of discussion regarding otters along the Katmai coast.
 AECOM indicates that this was left out originally as it is outside of the action area, but will add the information
 into the spills section of the EIS. NPS indicates that they have 2018 data pertaining to seals and sea otters
 along the Katmai coast and will send it to AECOM.
- AECOM gives an overview of comments received pertaining to brown bear movement and requests further
 clarification from ADFG. ADFG elaborates that while the analysis does examine published literature there is a
 lack of data in the region <u>about bear population</u>, so <u>cannot</u> to support conclusion language in the EIS. AECOM
 to revisit language in the section. <u>NPS recommended removing conclusion that impacts to brown bear
 populations would be in the range of their natural variability for lack of data to support conclusion.
 </u>
- USFWS expressed that the EIS should exercise caution when discussing the Mmarine Mmammal Perotection
 aAct (MMPA) and asked that USACE not make assumptions about future MMPA compliance as that is not
 justified. There is a lot of uncertainty around PLP's MMPA compliance. Additional USFWS comment on the

use of red lights as not being the current guidance. USFWS also indicated that the EIS should disclose that potential invasive species are not limited to vegetation.

- USCG posed the question to USFWS as to whether or not they are comfortable with the methodologies and
 data used pertaining to surveys of eagles, raptors, and migratory birds. USFWS indicated that they will
 continue to inform the applicant that they will have to work with USFWS as the project moves forward, but as
 for now to proceed with the current survey data. USFWS indicated that they currently have no legal authority
 but advise the applicant to take all precautionary measures moving forward.
- NPS raised concerns regarding a statement in EIS suggesting there are no measureable impacts on wildlife populations expected. For example, road use analysis focuses on trucks but does not mention support vehicles. The 21-minute interval between trucks is also a concern, should consider an 8-hour closure a day to allow predictable safe time for bears. NPS said the conclusion of no measurable impact on wildlife is not justified. NPS requested that the statement be revisited for accuracy. NPS also indicated there was a bear movement map that between-should be included in the EIS. Additionally, NPS and ADFG raised concerns regarding the description and representation of road traffic in the EIS. AECOM to review.

Subsistence

- AECOM begins reviewing topics pertaining to subsistence sections and asks EPA for clarification regarding first
 comment pertaining to the value of traditional foods. EPA elaborates on how traditional foods are shared
 throughout the subsistence network and that while it is uncomfortable to try and quantify the social costs of the
 loss of traditional foods, it is real to quantify how much the replacement food would be for people and
 suggested that doing so would be a worthwhile effort. Curyung echoed the concern and posed the question of
 how to quantify the value of culture that could be lost. AECOM to consider.
- EPA notes that this exercise has been done for other tribes throughout the nation and while it is not widely
 done, USACE may consider this. ADFG highlighted that subsistence data used in the EIS for communities is
 15-16 years old and a lot has changed since then. ADFG says more current subsistence baseline data is key.
 The Mulchatna caribou herd changes are one example of this. AECOM acknowledges this and clarifies that it is
 acknowledged in the EIS as a data gap.
- AECOM gives overview of next comment pertaining to the quality of traditional food and monitoring of food quality and asks for additional information and clarification pertaining to the comment. EPA elaborates that the comment refers to the health and quality of the food, suggesting that in the EIS there is no mechanism in place for monitoring the quality of food and associated health impacts such as the bio-accumulation of metals. The EIS must evaluate these impacts. AECOM indicates that there is a mechanism for this described in the EIS and it is included in the Human Health Sections 3.10 and 4.10. AECOM highlights that the social sections of the analysis are informed by the biological and physical analysis in the EIS and that social sections take into account all biological and physical impacts. ADFG: Technical Paper 549 addresses subsistence networks in Pedro Bay area, for example, and shows the role of super-harvesters who move around.
- AECOM reviews next comment pertaining to the analysis of medicinal plants in the EIS and indicates that AECOM is aware of this and will coordinate with the vegetation team to bolster the discussion of medicinal plants.
- AECOM reviews a comment pertaining to the inclusion of information on seals. AECOM notes that since the draft EIS they have incorporated additional information on seals and the Mulchatna caribou. EPA notes that subsistence did not give enough detail regarding liamna.lake.ireshwater seal harvests in local communities. EPA suggest more information about how, when, and where liamna.lake.ireshwater seals were harvested should be included. EPA elaborates that there could be an liamna.lake.ireshwater seal harvest network between communities in the region and that seal harvest is closely connected to the cultural variability of the region. AECOM to consider and asked for any specific helpful references. ADFG recommends specific technical papers [459 and 416) on the issue.
- NPS clarifies comment and raises concerns regarding the characterization of subsistence users who may be
 misplaced due to project impacts and recommends adding additional text highlighting the possibility of
 displacement creating competition or lack of/loss of local traditional subsistence knowledge. EPA and ADFG

echo the concern and highlight that displacement of subsisting communities could have more widespread impacts due to geographic limitations and challenges to subsistence. EPA notes the high use of the project area and that subsistence is place-based, so overall population level impacts on target fish and wildlife is not the only relevant metric for impacts to subsistence. To be forced from a place has potentially big impacts and access, resources in the area, and tradition all come into play. Nondalton notes that subsistence areas often are multi-generational, i.e., lish camps, and the EIS needs to look at these individually. Nondalton suggests the EIS should look at this in the cultural resources sections 3.7.4.7.3.9, and 4.9.

- AECOM gives an overview of comment pertaining to traditional ecological knowledge and asks if there is any
 additional information they should be aware of to consider and incorporate into the EIS. NPS notes that they
 are specifically interested in the inter-generational transmission of subsistence knowledge in local communities.
 NPS suggests that additional language could be added for clarity and consistency throughout the document.
 AECOM to consider. Curyung notes that they are working with ELM and the Federal Subsistence Board to get
 ANILCA Section 810 analysis and that this is relevant to NEPA analysis, USACE: let's talk more about that.
- Nondalton raises concerns that subsistence data is 15-16 years old and way be is inadequate and inappropriate to use in the analysis. USACE and AECOM clarify that this is the best available data to be used as per NEPA guidance and that language pertaining to the data process is included in section 3.1 of the EIS. Nondalton suggest that the EIS be more clear that the analysis is relying on historical subsistence data.

Additional Topics Discussed

- NPS raises concerns regarding environmental mass loading of metals due to water effluent and suggest there
 is a potential lack of toxicological impacts associated with effluent. NPS also indicates that this concern
 pertains to effluent discharges into marine waters as well. NPS says water quality needs to be looked at for all
 relevent over systems and the Gook Injet. Nondalton agreed, USACE to consider.
- Curyung noted that the 20-year mine plan results in significant degradation to waters of the US and is contrary to the public interest. Curyung also expressed concerns that the 20 year mine plan is not the real plan and suggests that the expanded scenario is the likely plan from the applicant. PLP save they have no current plans to mine more than 10% of the deposit over 20 years, but PLP also says as recently as March 5 that mining the rest is "likely." PLP did not provide a preliminary economic analysis and USACE has accepted the 20-year plan without question and with no objective basis. Economic feasibility affects the analysis of alternatives, for example, USACE screened out options such as dry tailings on the basis of being too costly. But how can the agency conclude that when desen't know the project's economics.
- Nondalton raised concerns regarding an apparent contradiction between section 4.9 and 3.7 regarding project
 footprint and suggested that south of Frying Pan Lake be included in the project footprint. Nondalton also
 questioned whether there would be a revised <u>Draft EIS and</u> an additional public comment period or if the next
 version will be the final. USACE indicated that the next version will be the final and there will not be another
 public comment period.
- USACE closes by giving an overview of next steps in the process of the development of the EIS, ROD, and decision making process for the Pebble Project.

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SUBSISTENCE

Curyung Tribal Council
Cooperating Agency Technical Comments on
the Pebble Project (POA-2017-00271)
Preliminary Final EIS



Introduction

In our role as a Cooperating Agency, Curyung Tribal Council (Curyung) submits these technical comments on the Army Corps' Preliminary Final EIS (PFEIS) for the Proposed Pebble Mine Project. While more time would be necessary to give the Corps a full picture of the lacking information and analysis and unsupported conclusions in the PFEIS, this document outlines Curyung's concerns and recommendations in the short time we've had to review.

Curyung objects to the limited time to review the PFEIS (45 days) in light of project changes and new analysis contained in the PFEIS that differs drastically from the Draft EIS. Changes to PLP's proposal are reflected in PLP's multiple modifications to its project description and revisions to its 404 permit application submitted to the Corps in January 2020. They are also reflected in PLP's responses to over 150 formal Requests for Information occurring after the release of the Draft EIS. Curyung notes that responses to Requests for Information are *still occurring during the cooperating agency review period for the PFEIS*, with 8 new or updated RFIs added to the project file in February and March 2020.¹

Because of the new information and new project designs contained in the PFEIS, Curyung strongly recommends the Corps issue a new Draft EIS for public review and comment, in order to comply with NEPA. In light of these recent changes and new analysis, the Draft EIS from last year was woefully inadequate to provide the "meaningful analysis" that NEPA requires.²

Curyung has significant concerns with the PFEIS analysis as well and recommends the below changes be incorporated, state permit applications submitted, and further field work undertaken prior to the Corps issuing a new Draft EIS for public review and comment. The missing information that would be provided from further field work and state permit applications is necessary to inform the NEPA analysis of impacts to salmon, salmon habitat, waters, subsistence, and the people of the Nushagak.

Chapters 1 & 2 and Appendix B – Purpose and Need, Alternatives Development, and Economic Feasibility

Curyung Tribal Council's Recommended Alternative. Curyung Tribal Council reiterates that the only acceptable alternative is the no action alternative. Moreover, Curyung notes that the PFEIS, by excluding any analysis of alternative mine designs and configurations, is inadequate to support the selection of a Least Environmentally Damaging Practicable Alternative (LEDPA) that would allow for the construction of the proposed Pebble Mine

Curyung Tribal Council Cooperating Agency Technical Comments on Preliminary Final EIS for the Pebble Mine Project

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¹ These new and updated RFIs made available during cooperating agency review of the PFEIS, and thus not incorporated into the PFEIS, include: RFI 21i Water Treatment Process Updated (March 17, 2020); RFI 163 Vessel Route for Bulk Carriers (March 9, 2020); RFI BSEE 2 Cook Inlet Natural Gas Pipeline Maintenance Schedule (March 5, 2020); RFI BSEE 1 Cook Inlet Natural Gas Pipeline Installation Methodology (March 5, 2020); RFI 162 Construction Schedule and Site Access During Construction (March 5, 2020); RFI 161 Watershed Model and Streamflow Change (Feb. 27, 2020); and RFI 149 Fish Habitat Modeling Results for Adult Resident Salmon by Stream Reach (Feb. 27, 2020).

² 40 C.F.R. § 1502.9.

Project. All proposed action alternatives in the PFEIS would result in very similar destruction to lands, waters, subsistence, cultural resources, and fish habitat and the Corps has failed to present a range of alternatives to avoid these impacts that would allow it to select the LEDPA as required under the Clean Water Act.

Recommendation: If the Corps moves to a Final EIS and ROD under the current record, it must deny the 404 permit application and in effect select the no action alternative. Otherwise, the Corps should revise the EIS with additional action alternatives that would lessen the impacts to resources (such as alternatives of smaller mine footprints, underground mining, dry stack tailings, removing the tailings from Bristol Bay, etc.) and reissue the EIS for public review and comment. As it stands now, the PFEIS fails to consider an adequate range of alternatives as required under NEPA.

Purpose and Need. The PFEIS fails to consider the broader public interest and need for this project, and thus the entire framework of the PFEIS analysis is flawed and in violation of NEPA. The Purpose and Need statement in Chapter 1 of the PFEIS responds only to the project applicant's needs, and not the needs of the Bristol Bay people. Failure to properly define the purpose and need has led to a faulty analysis of the range of reasonable and practicable alternatives in the EIS that has failed to consider the actual needs of mineral products versus the destruction of the world's greatest salmon commercial fishery and, importantly, the world's last salmon-based culture. Curyung notes that the proposed Pebble Mine project would do little to meet current demand for copper and other minerals, and would provide the global market with merely 56 days of supply based on 2017 demand.³ Moreover, global demand for copper is currently dropping and this new trend must be accounted for in this NEPA document, a the NEPA document must use the best available and current data to support its analysis.⁴ Demand for minerals – without the broader context of the importance of Bristol Bay salmon for the people of the region and their lifestyle and sustainable economy - leads to an unreasonable purpose and need statement and faulty EIS analysis.

Recommendation: Redefine the purpose and need statement, revise the project alternatives and EIS analysis accordingly, and reissue the revised Draft EIS for public review and comment. A proper purpose and need statement must reflect the broader public interest and need for this project. Revise the purpose and need statement to account for the reduced demand for copper and copper oversupply globally based on the most recent (March 2020) data regarding the demand for copper and other minerals.

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³ See USGS National Minerals Information Center, Copper Statistics and Information Annual Publication for 2018, available at: https://www.usgs.gov/centers/nmic/copper-statistics-and-information. ("The International Copper Study Group projected that global refined copper consumption would be approximately 24 million tons [48 billion pounds] in 2017."). 7.4 billion pounds from Pebble / 48 billion pounds global consumption annually = 0.1542 * 365 days per year = 56.3 days.

⁴ See, e.g., Wall Street Journal, Copper Slides as Coronavirus Hits Demand, Exchange Activity (March 23, 2020) https://www.wsj.com/articles/copper-slides-as-coronavirus-hits-demand-exchange-activity-11584973154; Reuters, Rupture of copper demand to fuel surplus as industry hit by virus (March 23, 2020), https://www.reuters.com/article/us-metals-copper-costs-graphic/rupture-of-copper-demand-to-fuel-surplus-as-industry-hit-by-virus-idUSKBN21A2PN

Screening of Alternatives without Economic Feasibility. The PFEIS Appendix B continues to rely on economic considerations as a mechanism for screening out project alternatives. Curyung reiterates its concerns that the Corps cannot screen out project alternatives based on cost without an adequate, independent review of the project's 20-year mine design. For example, the PFEIS Appendix B screens out dry stack tailings storage and underground mining, two alternatives that, if assessed in the EIS document, might prove to have lesser impacts to fish, fish habitat, and subsistence from the current proposed design. Without this information, the Corps cannot reasonably screen out project alternatives as too costly.

The Corps' reliance on any economic assertions from PLP are arbitrary, as the company has failed to provide an economic feasibility report for its proposal and instead provided an insufficient economic model to the Corps in RFI 059a. Meanwhile, according to the company's most recent filings with the Securities and Exchange Commission, it has not selected a final mine design and has not shown its current NEPA project to be economically feasible, indicating future project changes might still occur:

- "Northern Dynasty, through the Pebble Partnership, also continues to advance engineering studies. Northern Dynasty cautions that the current Project Description may not be the ultimate development plan for the Pebble Project and that a final project design has not been selected"⁵
- "the Company cautions that the plan described above may not be the final development plan. A final development design has not yet been selected." 6
- "The proposed project uses a portion of the currently estimated Pebble mineral resources. This does not preclude development of additional resources in other phases of the project in the future ..."
- "There can be no assurance that any future economic or technical assessments undertaken by the Company with respect to the Pebble Project will demonstrate positive economics or feasibility." 8

Since the Corps has used project economics as a criterion for screening out project alternatives, it must use the best available information to base its alternatives screening decisions. The Corps has failed to do so, RFI 059a is lacking sufficient detail and is based on arbitrary project assumptions. Thus, the entire NEPA analysis that flows from the assumption that the 20-year mine design is economically feasible is faulty.

Recommendation 1: Require a full, independent economic feasibility report in compliance with Canadian securities law NI 43-101 for the proposed 20-year mine design, in accordance with the Army Corps' authority to require independent economic feasibility of projects, pursuant to its public interest review regulations at

https://www.sec.gov/Archives/edgar/data/1164771/000149315219018260/ex99-2.htm.

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⁵ Northern Dynasty Minerals Ltd., Management's Discussion and Analysis Three and Nine Months Ended September 30, 2019 (filed with the SEC on Nov. 22, 2019), at page 7, *available at*:

 $^{^{6}}$ \overrightarrow{Id} at page 9.

⁷ *Id*.

⁸ *Id* at page 27.

33 C.F.R. § 320(q). Pequire that PLP re-submit its economic model in RFI 59a based on the independent economic feasibility report.

Recommendation 2: Require that PLP's economic model in RFI 059a be amended to contain a similar level of analysis as its 2011 Preliminary Economic Assessment and to be updated properly from the 2011 report. For example, the following information, assumptions, and sensitivity analyses should be undertaken and updated in the RFI 059a economic model for the Corps to have an adequate evaluation of the economic feasibility of the project and project alternatives:

- Adjustments for inflation PLP's RFI 059a economic model is based on capital and operational expenditures in PLP's 2011 Preliminary Economic Assessment (PEA), and as such these capital cost figures are based on 2011 dollars. PLP's RFI 059a economic model is identical to the 2011 PEA for the following capital costs: other infrastructure, tailings, access road, port infrastructure, and power generation. These figures must be updated to account for inflation. The model must be re-run by accounting for inflation, as proper capital expenditure figures are necessary to obtain an accurate calculation of the net present value.
- Updated estimations of capital expenditure costs Likewise, PLP's RFI 059a economic model is based on capital costs calculated in its 2011 Preliminary Economic Assessment and cannot be relied on because the current infrastructure proposed differs substantially. While the RFI 059a economic model includes some adjustments for capital costs for mining, process, moly separation, secondary gold recovery, and power generation, it does not include adjustments for capital expenditures for other infrastructure, tailings, access road, and port infrastructure. These components differ substantially from the 2011 PEA, and update capital expenditure figures are required for an accurate net present value calculation. Moreover, because capital costs of mining projects are unpredictable and usually underestimated, a sensitivity analysis for the capital costs must be included, as was undertaken in PLP's 2011 PEA.
- Adjustments for local, state, and federal tax revenues and royalties (annually)

 PLP's RFI 059a economic model fails to incorporate annual local, state, federal, and corporate income taxes and royalties. These figures can be quite substantial and will impact the annual cashflow, revenues, and calculation of net present value. As shown in PLP's 2011 Preliminary Economic Assessment, the pre-tax and post-tax numbers can differ substantially. PLP currently touts the following annual tax figures that should be taken into consideration: \$49-66 million annually for state taxes and royalties and \$19-21

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⁹ 33 C.F.R. 320(q) ("the district engineer in appropriate cases, may make an independent review of the need for the project from the perspective of the overall public interest. The economic benefits of many projects are important to the local community and contribute to needed improvements in the local economic base, affecting such factors as employment, tax revenues, community cohesion, community services, and property values.").

¹⁰ Compare initial capital costs from 2011 PEA (available here: https://www.northerndvnastyminerals.com/news/news-releases/2011/northern-dynasty-receives-positive-preliminary-assessment-technical-report-for-globally-significant-pebble-copper-gold-molybdenu/) to the RFI 059a capital costs.

See Northern Dynasty Minerals Ltd. and Wardrop, Preliminary Assessment of the Pebble Project, Alaska (Fe. 15, 2011), at page 487.

- million annually to Lake and Peninsula Borough revenue taxes. ¹² Corporate income taxes which can be as high as 30% must also be taken into consideration when calculating the net present value of the 20-year mine.
- Sensitivity Analysis for Mineral Prices The world is currently experiencing a drastic and fast-paced decline in metal prices, with the price of copper falling by 22% this year alone. ¹³ As noted in PLP's 2011 Preliminary Economic Assessment, the Pebble project economics are extremely sensitive to metal price fluctuations. ¹⁴ As such, the 2011 report conducted a sensitivity analysis for metal prices, analyzing the impact of various metals prices on the project's net present value. RFI 059a should include the same sensitivity analysis. However, RFI 059a includes only one set of metals values and assumes a copper price of \$3/lb, when in fact the current price of copper is \$2.17/lb. A sensitivity analysis of various metals prices is necessary for a reliable net present value calculation.
- Accounting for Post-Year 20 PLP's RFI 059a economic model inappropriately stops at mining year 20. Stopping the model abruptly means that it fails to account for any costs post-dating year 20, when PLP says it will begin closing and reclaiming the mine. Closure and reclamation is a costly endeavor and would weigh negatively on the net present value of the entire project, as there is no income at the time to offset its costs. And yet, PLP's net present value calculation in RFI 059a fails to consider any of the costs post-year 20, meaning all costs associated with water treatment, reclamation, remediation, long-term monitoring, and closure. The failure of PLP's RFI 059a economic model to include this information when calculating net present value is a fatal flaw. The model must be revised and extended beyond year 20 to account for these costs, and be re-run to calculate the net present value.

Recommendation 3: Review the results of an independent economic feasibility report and revised RFI 059a and revise the EIS purpose and need statement and selection of alternatives accordingly. It is Curyung's contention that the 20-year mine design itself is not economically viable and PLP would need to expand its operations beyond the 20-year mine pit. The EIS document must account for this eventuality, and the alternatives assessed must include this possibility and describe the impacts on project design. For one example, if PLP continues mining beyond year 20, the company will not be placing the pyritic tailings back into the open pit at year 20, but would rather need to store the pyritic tailings in a storage facility until mining is completed. What would such a tailings facility look like? Where would it be located? What will its design parameters be? What is the likelihood of failure? How much salmon habitat will it destroy? And what are the impacts of this facility long-term on the people of the Nushagak? These questions of economic feasibility and impacts from expansion are essential to understanding the proposed Pebble mine project and remain unanswered in the PFEIS.

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¹² https://www.northerndynastyminerals.com/site/assets/files/4802/ndm 4pager feb262020-web.pdf

¹³ https://www.macrotrends.net/1476/copper-prices-historical-chart-data.

¹⁴ See Northern Dynasty Minerals Ltd. and Wardrop, Preliminary Assessment of the Pebble Project, Alaska (Feb. 15, 2011), at page 487.

Chapter 3.7 – Cultural Resources

Affected Environment Not Adequately Described. The PFEIS fails to adequately describe the importance not just of the fish themselves but also the humans that are dependent on those fish populations. Our cultural identity is directly tied to salmon. The Nushagak River people are inadequately described in the PFEIS and impacts to our people are ignored. The Nushagak is the only river that flows in Bristol Bay that had two different and distinct cultures living along the river at the time of contact – the Aglegmuit of the lower river and bay and Kiatagmiut of the upper river.

Recommendation: The Corps must do a more complete literature review and incorporate information about the Nushagak peoples in the EIS document. The following resources to help provide for a more complete description of cultural resources, for example:

- VanStone, Eskimos of the Nushagak River: An Ethnographic History, Seattle: University of Washington Press, 1967¹⁵
- Nushagak-Mulchatna Watershed Council (NMWC) 2007 Nushagak River Watershed Traditional Use Area Conservation Plan. Dillingham and Anchorage: Bristol Bay Native Association, Curyung Tribal Council, and The Nature Conservancy.

Ongoing Surveys and Missing Information. The PFEIS admits that cultural resource surveys and ethnographic research is ongoing and incomplete. This information is critical to inform an analysis of the NEPA and LEDPA alternatives. Indeed, the NEPA process is supposed to be informed by the National Historic Preservation Act 106 process, which has yet to conclude and the Corps has failed to properly use the 106 process to inform the NEPA alternatives throughout this process. PLP has yet to submit a Cultural Resources Management Plan (CRMP) for incorporation into the EIS document. The CRMP is a document that the entire public should be given the opportunity to review and comment on and it, alongside new and ongoing cultural resources survey information, should be provided to the public for review and comment.

Recommendation: Require PLP to complete all cultural resource surveys and ethnographic research currently underway and all surveys and research PLP has planned for 2020. Revise the EIS only after all information has been obtained from PLP and adequate surveys have been finalized. Once all information is provided to the Corps, revise the EIS and reissue it for public review and comment. Allow the public the opportunity to comment on the CRMP.

Chapter 3.9 – Subsistence

Inclusion of an ANILCA 810 Analysis – Impacts to 17b Easements. The PFEIS fails to acknowledge that a subsistence impacts analysis is legally required pursuant to ANILCA. Section 810 of ANILCA provides:

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¹⁵ https://www.worldcat.org/title/eskimos-of-the-nushagak-river-an-ethnographic-history/ocle/244587

"In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions, the head of the Federal agency having primary jurisdiction over such lands or his designee shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes."

The PFEIS concludes that an evaluation of subsistence impacts pursuant to Section 810 is unnecessary because there are no federal lands in the project area. "There would be no project components proposed on federal lands where the subsistence management provisions of ANILCA would apply." But the PFEIS is incorrect. All action alternatives implicate impacts to ANCSA Section 17b easements. As noted in the PFEIS Chapter 3.2:

The Applicant's Preferred Alternative would cross three Section 17(b) easements (two also crossed by Alternative 1 or Alternative 3, and one is off the Iliamna-Newhalen Road). Alternative 1 would intersect 1 Section 17(b) easement, on the southern shore of Iliamna Lake. Alternative 2 and Alternative 3 would intersect 2 Section 17(b) easements; both begin at the northern shore of Iliamna Lake and continue north

ANCSA Section 17b easements are public lands, reserved by the U.S. for access to public land and water on lands that have been or will be conveyed. ANCSA Section 17b easements provide access to subsistence opportunities on publicly owned land, and as such, are subject to ANILCA Section 810.

Recommendation: Curyung reiterates our request to the federal government evaluate the subsistence impacts of the proposed alternatives under ANILCA Section 810. The Corps must not proceed to a Final EIS until an ANILCA Section 810 analysis is complete and the public has had the opportunity to review and comment on this analysis in a revised Draft EIS.

Chapter 3.10 and 4.10 – Health and Safety

Health Impact Assessment. Curyung reiterates our request for a Health Impact Assessment, conducted by the Corps and the State of Alaska, and incorporated into the EIS document. The people of the Nushagak River, downstream from the mine site, will be adversely impacted by construction and regular operation of the mine for more than two decades. These health impacts are not adequately assessed in the PFEIS. Health Impact Assessments offer a systemic methodological framework for factoring public health concerns into decision

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making. ¹⁶ A Health Impact Assessment should pay particular attention to the determinants and associated feedbacks that contribute to public health and wellness in rural Alaska. ¹⁷ Health Impact Assessments are widely used in NEPA documents throughout Alaska and health impacts are a requirement of NEPA. Pebble mine is the largest proposed development project for southwest Alaska ever and will have lasting impacts to the health of the people who live downstream. The PFEIS ignores a broad range of health impacts to the people downstream of the mine, and does so by failing to undertake a Health Impact Assessment. Without an assessment, the PFEIS's conclusions that mitigation will minimize health effects and compliance with existing regulations will prevent health impacts is premature and unreliable.

<u>Recommendation</u>: Conduct a Health Impact Assessment for the proposed Pebble Mine Project, and revise the EIS accordingly and incorporating information from the assessment. Issue a revised EIS for public review and comment.

Chapters 3.18 and 4.18 – Water Quality

Conceptual Project Design; State Permits Needed to Properly Analyze. Water treatment and storage is a concern for Curyung, as PLP is proposing to use unproven technology on an unproven scale in an unproven climate at the headwaters of Bristol Bay's salmon. According to the PFEIS, the water PLP proposes to treat "would be elevated in several metals that would exceed WQC [water quality criteria]." The EIS discloses that the water PLP intends to treat contains "elevated levels of aluminum, arsenic, beryllium, cadmium, copper, lead, manganese, mercury, molybdenum, nickel, selenium (a metalloid), silver, and zinc in exceedance of the most stringent WQC." 18

According to the PFEIS, PLP is proposing to treat 38,779,012 gallons per day of mine contact water, slurry, and storage water (combined based on two proposed WTPs) under the 20-year mine design. and 52,820,000 gallons per day (approximate) under the 78-year mine design. These figures have increased <u>substantially</u> from the Draft EIS figures for water treatment. The PFEIS water treatment for the 20-year mine design is a 40% increase over the figures for water treatment in the Draft EIS.

This proposed water treatment is orders of magnitude larger than treatment at any other hardrock mine in Alaska. However, PLP has failed to provide the Corps with anything more than conceptual-level proposals to treat this unprecedented amount of mining water. And the Corps has allowed PLP to move through the NEPA process without providing the information necessary to analyze the proposed project and alternatives impacts on water quality, fish and fish habitat, and in turn on people of Bristol Bay. The PFEIS does not

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¹⁶ National Research Council 2011. Improving Health in the United States: The Role of Health Impact Assessment. Washington, DC: The National Academies Press. Appendix A at 150–161. https://doi.org/10.17226/13229.

¹⁷ Loring, P.A. and Gerlach, S.C. (2009). Food, culture, and human health in Alaska: an integrative health approach to food security. Environmental Science and Policy, 12: 466-478.

¹⁸ Preliminary Final EIS, Executive Summary, at page 104.

¹⁹ Preliminary Final EIS, Executive Summary, at page 12 (two water treatment plans proposed to treat influent of 14 cfs and 46 cfs (60 cfs total) converts to 26,929.87 gallons per minute).

²⁰ Preliminary Final EIS, Chapter 4.1, Table 4.1-2: Assumptions for Pebble Project Expansion.

²¹ Compare Draft EIS page 2-33 (proposed influent flow of 43 cfs) to PFEIS page 2-36 (proposed influent flow of 60 cfs).

provide adequate details to know whether PLP will be meeting water quality standards for human health and aquatic life.

Recommendation: PLP must apply to the Alaska Department of Environmental Conservation for Alaska Pollutant Discharge Elimination System permits for discharging its treated water. The State of Alaska recently stated that Pebble "will undoubtedly change, perhaps significantly so," during the State permitting process. 22 Because PLP's proposed water treatment plans will undoubtedly change during the state permitting process, the Corps should not issue a Final EIS until PLP has been awarded the necessary APDES permits through the state permitting process. Once PLP has received its APDES permits and has settled on a final design for its water treatment plants, the Corps must re-issue the EIS for public review and comment, as the information will differ drastically from the information provided in the 2019 Draft EIS, as already evidenced by the changes from the Draft EIS to the PFEIS.

Chapter 3.23 - Wildlife - Mulchatna Caribou Herd

Updated Baseline Numbers. The PFEIS fails to account for the most recent Mulchatna Caribou Herd information. The PFEIS states that the herd's population is around 27,000. However, the population this year is around 13,500 or below. In fact, ADF&G and DOI closed hunting this year because of the herd's reduced size.²³

<u>Recommendation</u>: Amend the figures in the EIS to account for the changes in the herd population over time, including the latest numbers from 2019.

Chapters 3.34 and 4.24 – Fish Values

Updated Baseline Information and Additional Surveys Required. PLP has failed to survey for fish throughout the project footprint. However, according to ADF&G, the agency has found salmon presence in stream locations surveyed by PLP's contractors where PLP found no salmon present.

<u>Recommendation</u>: Analysis of impacts to fish and fish habitat from project components, specifically roads and culverts and ferry locations, requires additional baseline information, such as:

- Habitat typing stream widths and depths, gravel typing, bank vegetation, instream vegetation, steam flow, stream temperature, stream conductivity
- Salmon and other resident fish presence for all life stages and each location surveyed multiple times per year
- Hydrology analysis of hydraulic and hydrology components at all stream crossings and impacted habitat

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²² State of Alaska's Motion to Intervene, *Bristol Bay Economic Development Corporation*, v. *Hladick*, (3:19-cv-00265), filed February 8, 2020, page 18. https://www.courtlistener.com/recap/gov.uscourts.akd.62717/gov.uscourts.akd.62717.51.0.pdf. ²³ DOI Federal Subsistence Management Program, Mulchatna Caribou Seasons Closed on Federal Public Lands Throughout Range of the Mulchatna Caribou Herd (Dec. 26, 2019), https://www.doi.gov/subsistence/news/general/mulchatna-caribou-seasons-closed-federal-public-lands-throughout-range; KDLG, ADFG to close Mulchatna caribou hunt on state lands (Jan. 28, 2020), https://www.kdlg.org/post/adfg-close-mulchatna-caribou-hunt-state-lands.

Chapter 4.27 – Tailings Dam Failure and Flow Modeling

Tailings Dam Design and Baseline Data Inadequate for NEPA Review. Two months prior to the release of the PFEIS, an internal memo authored by engineers at AECOM warned of the risks to PLP tailings facility integrity without additional field data and testing:

testing completed to date on the bulk tailings has been minimal. [...] Thus, the summary of expected particle size sorting behavior [...] in the RFI response [from PLP] is incomplete and misleading. [...] The ability to operate as a flow-through drained facility can only be confirmed with Pebble-specific tailings testing [...] We remain concerned that there are uncertainties as to whether the 55 percent thickened tailings planned by PLP would segregate enough to promote reduction of the phreatic surface near the embankment, which translates to uncertainties regarding the effect of tailings segregation on embankment stability.²⁴

PLP's response to AECOM's requests throughout the NEPA process for more geotechnical information, specific tailings testing information, and more specific designs has been that PLP refuses to provide such information. Examples of PLP refusing to provide this information include:

- "PLP is not proposing to finalize the 2018 geotechnical fieldwork report until after additional monitoring data for the holes drilled has been collected." PLP response to RFI 009g (June 10, 2019)
- "Site-specific tailings testwork will be completed to support the preliminary design phase of the ADSP. Results from this testwork will be used to validate the material parameters, and if required, update the liquefaction analysis and embankment design during the preliminary and detailed design phases. The testwork will include index testing to enable geotechnical classification of the materials, slurry settling, air drying, consolidation and permeability testing, and strength testing to determine the characteristics the tailings." PLP response to RFI 008h (Sept. 20, 2019)
- "The tailings testing program, which is expected to be completed during the preliminary design phase of the Alaska Dam Safety Program, will include index testing to enable geotechnical classification of the materials, slurry settling, air drying, consolidation and permeability testing to determine the characteristics the tailings. This testing will occur under a range of conditions to be representative of expected field conditions. Results from this testwork will be used to validate the sensitivity analyses and material parameters used in the seepage analysis completed to date." PLP response to RFI 008h (Sept. 20, 2019)
- "The design of the embankment structures, including detailed stability analyses will be completed as per the design requirements outlined in the ADSP." <u>PLP response</u> to RFI 008h (Sept. 20, 2019)

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²⁴ AECOM, Technical Memorandum to Bill Craig, AECOM (Dec. 13, 2019), Pebble Project EIS – Bulk TSF Embankment Seismic Stability Analysis, at pp. 1-2, available at https://pebbleprojecteis.com/files/86882482-1f9a-4846-8fa5-354c4f5a8230.

- "The stability analysis will be updated on an ongoing basis as the preliminary and detailed design phases of the ADSP are advanced." PLP response to RFI 008h (Sept. 20, 2019)
- The locations of these [tailings facility] drains are to be determined..." <u>PLP</u> consultant response to RFI 109e (July 25, 2019)

PLP's refusal to provide AECOM this information, and the Corps' allowance of PLP's deferral to a future state permitting process, means the analysis of potential impacts from the project is not using the best information and best science. Robust scientific analysis in the context of such large gaps requires more than one round of review and input from experts and is a necessary step to ensure scientific and public integrity for the Corps' EIS.

Recommendation: The Corps should require PLP to provide the above missing information, and all other missing information identified by cooperating agencies and AECOM related to dam design and geotechnical hazards, necessary for analyzing tailings dam design and impacts from the project. Adequate information likely requires additional field work from PLP, as well as state applications for dam safety. The Corps should align its NEPA process with the Alaska Dam Safety Program process for a more comprehensive and efficient review of the dam design and potential impacts. Once the Corps obtains this information and PLP has submitted its applications for dam safety, the Corps should issue a revised Draft EIS for public review and comment.

Groundwater Data Incomplete. According to PLP's latest filing with the Securities and Exchange Commission, in summer 2020, PLP plans to conduct "pump tests to confirm groundwater characteristics" at the mine site.²⁵ This information is necessary for the EIS document, as it will be important to help inform the groundwater characteristics and might result in revisions to PLP's groundwater model (recently revised in 2019 after the Draft EIS).

Recommendation: Obtain data from PLP's 2020 groundwater pump tests and include this information in the EIS document. Once the new data has been incorporated in the document, release a revised EIS for public review and comment.

Full Failure Modeling. Curyung reiterates its request that the Corps model full dam failure scenarios for the 6 major embankments proposed for the headwaters of the Nushagak River watershed. Those 6 major embankments include:

Bulk TSF – Two Dams:

Main = 545 feet high

South = 300 feet high

South = 215 feet high

East = 225 feet high

 $\underline{\text{Main WMP} - \text{One Dam}} = 190 \text{ feet high}$

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²⁵ Northern Dynasty Minerals Ltd., Management's Discussion and Analysis, Three and Nine Months Ended September 30, 2019, page 11, available at: https://www.sec.gov/Archives/edgar/data/1164771/000149315219018260/ex99-2.htm.

In the past cooperating agency meetings, Curyung has informed the Corps that any modeling of dam failures should include flow modeling the entire length of the Nushagak River and over long-term time scales. We reiterate our request here. Flow modeling cannot stop in time and place based on arbitrary constraints. Modeling must account for the full range of impacts that might occur. Subsistence and fishing activities throughout the river and tidelands are already impacted from erosion and deposition from the Nushagak River, and understanding how this may change as a result of tailings deposition is an important consideration for the EIS analysis that is currently overlooked.

Dam failures will have a lasting impact on fish and fish habitat and cumulatively will impact Curyung and its members and the entire community. Since the PFEIS has failed to analyze the loss to fish and fish habitat from a dam failure, then the EIS cannot draw reasonable conclusions about the impacts of this loss to the people who use the fish. Salmon is an important cornerstone of food security in the region and our economy, and we are the last salmon-based culture in the world. All of this will be impacted in turn by a dam failure on the Nushagak River system.

Recommendation: Revise the EIS to include modeling of failures at all 6 major embankments. In the failure modeling, including tailings flow and deposition modeling that extends all the way down the Nushagak River to the bay and extends over long-term time scales. Once this information is included in the EIS document, issue a revised EIS for public review and comment. The dam failure modeling is an important consideration for the public's view of the project alternatives, including dam design.

Climate Change and Water Balance. The PFEIS continues to rely on old data to make conclusions about water balance. This data is inadequate to assess the future water balance problems that might occur if the mine is built. Climate change will increase the amount of rain in the region, increase rain on snow runoff events, and will increase the number of freeze-thaw events. All of which in turn will impact the stability of the proposed earthen dams holding back billions of gallons of water. TEK information tells us that we're seeing increased slips deep in the tundra as it thaws out rapidly and our rain events increase. The PFEIS doesn't address climate change and how increased precipitation and increased freeze-thaw events will impact the probability of failure.

<u>Recommendation</u>: Revise the water balance analysis to account for climate change predictions of increased water. In turn, analyze the impact of climate change causing increased rain on snow runoff events, increased freeze-thaw events, and increased tundra erosion and how these will impact dam stability.

Chapter 4.3 – Regional Infrastructure and the No Action Alternative

Inconsistent Characterization of Impacts to Regional Infrastructure. In section 4.3.2.1 on page 4.3-4 Regional Infrastructure, the PFEIS concludes that the No Action Alternative "would not affect current or proposed infrastructure including education, health services, water, transportation, sewer, and solid waste operations." However, the PFEIS on section

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4.3.2.2 Potentially Affected Communities says "Under the NAA, populations trends would continue. Declining populations in some communities can lead to school closures and other loss of services." This second statement is completely contradictory to the claim made just sentences before it.

<u>Recommendation</u>: Suggest deleting references throughout the PFEIS that claim human populations throughout the Bristol Bay region will decline over time under the No Action Alternative. There is no evidence to support this contention. Moreover, other places in the EIS contain the contrary conclusion.

Chapter 5 – Mitigation

Inadequate Mitigation for Impacts to Cultural Resources. The PFEIS fails to contain adequate and definitive measures to prevent adverse impacts to cultural resources. As a preliminary matter, the PFEIS fails to fully describe the cultural resources impacted by the project to the Nushagak people. If the impacts are not properly described, the proposed mitigation can never be effective.

Curyung has not been properly consulted on what potential mitigation measures would be the most effective for the people of the Nushagak River. All mitigation measures contained in the PFEIS are *conceptual only* and cannot be relied on to minimize the impacts from the project, as there are no enforcement mechanisms to ensure they will be carried out. Examples of promises for future, speculative mitigation efforts without enforcement and lacking the necessary details outlined in Chapter 5 include:

- "Cultural resource experts <u>would be</u> retained during construction activities to respond to any potential cultural sites identified during construction."
- "A Cultural Resources Management Plan (CRMP) <u>would be</u> developed for the project."
- "Drug and Alcohol Abuse Prevention, Cultural Sensitivity, Safety, and other workplace programs *would be* developed for all employees."

Recommendation: Curyung recommends the Corps provide the details of these plans and mitigation measures for the Tribe to review. Unless we know what is specifically being proposed to mitigate impacts to cultural resources, we cannot effectively comment on the adequacy of these measures and what else needs to be undertaken to mitigate impacts to cultural resources. This information should be detailed in a revised Draft EIS.

Appendix D – Responses to Public Comments

Appendix D contains a poor presentation of the public comments received on the Draft EIS and how the agency responded to comments and made changes for the PFEIS. This makes it difficult for Curyung, our members, the general public, cooperating agencies, and other experts to understand how the Corps responded to their specific comments on the Draft EIS. Curyung's name does not appear once in the Appendix D, despite multiple comments we made on the record on the Draft EIS. We cannot know how the Corps has or has not

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responded to our concerns with the presentation of Appendix D. Indeed, Appendix D fails to include the amount of detail provided in other NEPA documents for projects in Alaska.

Recommendations:

- For each statement of concern listed in the appendix, include the source of the concern (agency, group, expert, member of the public, etc.).
- For each statement of concern, include direct quotations from the comment letter or oral testimony so that the public does not have to rely on the Army Corps' characterization of the issue, but can rather read the original comment verbatim.
- For the introduction to the comment analysis report (D1.0-D1.3), include a better description of the comments received on the Draft EIS. For comment submissions that were form letters and unique letters, include the percentages supporting the 3 different action alternatives. The Corps should quantify the support for the various alternatives in some way to help decisionmakers analyze the public interest review for 404 permit. In addition for these percentages, identify what percentage of Bristol Bay residents support the no action alternative in comments to the Army Corps. Include information on the number of comments submitted by Alaska residents.
- For the comment analysis report, there should be a summary of all the oral testimony received at the Draft EIS public hearings. This summary should include the statements of concern in each community. This summary should also include the percentages of support for the various alternatives and be broken down by location.

Appendix K Generally

Curyung Tribal Council is concerned that the PFEIS does not comply with NEPA standards for EIS documents. NEPA requires that the analysis of a proposal be included in the main text of the NEPA document, and not be relegated to appendices. Many of the impacts to the Nushagak people, downstream from the proposed mine site, are not described or analyzed in the main body of the EIS document.

Recommendation: The Corps must include analysis of all impacts in the main body of the EIS, and not segregate the description of important downstream impacts into Appendix K.

Appendix K3.1 - Traditional Ecological Knowledge

Generally. Appendix K3.1 contains information valuable obtained from Traditional Ecological Knowledge (TEK) sources, to describing the affected environment and should be better incorporated into the main body of the EIS document.

Recommendation: The Corps must include analysis of all impacts in the main body of the EIS, and not segregate the description of important downstream impacts into Appendix K.

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Downstream Affected Environment: The TEK information gathered and used by the Corps focuses primarily on the mine site and project footprint. Thus, the PFEIS fails to include significant TEK about the Nushagak River people and baseline conditions downstream of the mine site. Curyung specifically has provided input to the Corps through its role as a cooperating agency and in tribal consultation regarding the baseline conditions of the Nushagak River and its tributaries. This TEK was apparently ignored, as the Appendix K3.1 sections on cooperating agency and tribal consultation input fails to include information related to the Nushagak River watershed.

Recommendation: The Corps should honor Curyung's request for government to government consultation on this issue and use the TEK information from these consultation meetings to inform the affected environment sections of the EIS. Once the EIS contains updated TEK information describing the affected environment of the Nushagak River watershed, the Corps should re-issue the EIS for public review and comment.

Existing Documents. The TEK information noted in Appendix K under "existing documents" fails to include information relevant to the Nushagak people. The PFEIS cites to PLP's Environmental Baseline Document chapters on subsistence; however, TEK expands beyond the topic of subsistence and should be used to describe many aspects of the affected environment, including climate, water flow, erosion, plant distribution, fish migration patterns, mammal migration patterns, and the like. The PLP Environmental Baseline Documents cited here are also outdated (based on interviews taken in early 2000s) and updated TEK information about the mine site has been collected by the EPA and PLP contractors since then that should be incorporated into Appendix K3.1 and the main body of the EIS document.

Recommendation: The Corps should do a more thorough job describing the affected environment utilizing TEK, and not limit the scope of TEK to subsistence information only. TEK serves to provide important information on a wide variety of affected resources and the Corps has not done an adequate job compiling and utilizing this information for the Nushagak River watershed especially. The Corps should conduct more government to government meetings with the tribes in the Nushagak River watershed, including Curyung, and use the TEK information from these meetings to better describe the affected environment. Once a broader picture of the affected environment is presented in the EIS, the Corps should re-release a revised EIS for public review and comment.

Appendix M – Compensatory Mitigation Plan

Public Process. Curyung Tribal Council requests the Army Corps allow for a public comment period on PLP's final compensatory mitigation plan. For efficiency, Curyung recommends that the Army Corps provide this public comment period simultaneously to another public comment period on the revised EIS. The Clean Water Act requires that the Army Corps provide the public an opportunity to provide comments on mitigation of impacts

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to wetlands and waters. The draft compensatory mitigation plan provided in the Pebble Project Draft EIS differed significantly from the current draft compensatory mitigation plan, with new proposals and changes to the projected impacts to wetlands and other waters. In addition, the practice of the Army Corps Alaska District has been to allow the public an opportunity to comment on final compensatory mitigation plans, as was the case in the Donlin Mine when the Army Corps allowed for comment on the compensatory mitigation plan for that project.

Recommendation: Provide a public review and comment period of at least 30 days on PLP's final compensatory mitigation plan.

Permittee-Responsible Mitigation. Curyung Tribal Council opposes the use of permitteeresponsible mitigation as the sole means of fulfilling mitigation requirements.

Recommendation: Require all proposed mitigation measures for the Pebble Mine project have financial assurances of some kind.

Failure to Mitigate for Lost Wetlands. PLP's final compensatory mitigation plan contains zero mitigation for wetlands lost from the project. Under the 20-year mine, the project will result in direct and permanent loss of 2,226 acres of wetlands and other waters, 859 acres of temporary impacts to wetlands and other waters, and indirect impacts to 2,019 acres of wetlands and other waters.²⁶ Under the Clean Water Act, projects are required to compensate for lost wetlands. The proposed Pebble Mine Project will result in wetlands destruction in pristine waters supporting the world's most abundant sockeye salmon run, as well as important foods like king salmon. Losses of such productive and important wetlands cannot be permitted under the Clean Water Act without mitigation of some kind.

Recommendation: Require mitigation for wetlands losses.

Inadequate Mitigation of Loss of Salmon Habitat. The lost salmon habitat will all occur in the Nushagak River system, and yet nearly all of the proposed permittee-responsible mitigation efforts take place far outside of this watershed.

Recommendation: Require mitigation for lost salmon habitat in the Nushagak River watershed. The Corps should pursue an open and public process to identify potential mitigation projects in the Nushagak River watershed, and not just seek input from cooperating agencies on mitigation projects. To do otherwise is to artificially limit potential mitigation options to information provided by only a subset of relevant and knowledgeable people. Should the Corps undertake such a process it may identify wetland, waste water treatment, fish passage and other options in the Nushagak River watershed.

Inadequate Mitigation for Water Quality. PLP is proposing to treat and discharge 38,779,012 gallons of water a day for 20 years, and a similar amount of gallons per day postclosure. The water PLP proposes to treat will contain elevated levels of: aluminum, arsenic,

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²⁶ Preliminary Final EIS, Executive Summary, at page 82.

beryllium, cadmium, copper, lead, manganese, mercury, molybdenum, nickel, selenium (a metalloid), silver, and zinc. Inevitably, there will be failures of the water treatment systems and exceedences of water quality standards in the Nushagak River downstream from the proposed mine. However, PLP's final compensatory mitigation plan fails to include any mitigation for lost water quality in the Nushagak River watershed.

Recommendation: Require mitigation for impacts to water quality in the Nushagak River watershed specifically. The Corps should pursue an open and public process to identify potential mitigation projects in the Nushagak River watershed, and not just seek input from cooperating agencies on mitigation projects. To do otherwise is to artificially limit potential mitigation options to information provided by only a subset of relevant and knowledgeable people. Should the Corps undertake such a process it may identify wetland, waste water treatment, fish passage and other options in the Nushagak River watershed.

Curyung Tribal Council Cooperating Agency Technical Comments on Preliminary Final EIS for the Pebble Mine Project

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Curyung Tribal Council
Cooperating Agency Technical Comments on
the Pebble Project (POA-2017-00271)
Preliminary Final EIS

Supporting Studies, Reports, and Literature for Inclusion in the EIS

Curyus

- 1. Sean R. Brennan, Daniel E. Schindler, Timothy J. Cline, Timothy E. Walsworth, Greg Buck, Diego P. Fernandez. Shifting habitat mosaics and fish production across river basins. *Science*, 2019; 364 (6442): 783 DOI: 10.1126/science.aav4313
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- 4. Russian Exploration in Southwest Alaska: The Travel Journals of Petr Korsakovskiy (1818) and Ivan Ya. Vasilev (1829) published by UAA via the Rasmuson Library, https://journalhosting.ucalgary.ca/index.php/arctic/article/view/64966/48880
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- 8. ADF&G Technical Paper 326, Sharing, Bartering and Cash Trade of Subsistence Resources in the Bristol Bay Area, Southwest Alaska by Kreig, Fall, Chythlook, LaVine and Koster, http://www.adfg.alaska.gov/download/indexing/Technical%20Papers/Tp326.pdf
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CONSERVATION

Shifting habitat mosaics and fish production across river basins

Sean R. Brennan^{1*}, Daniel E. Schindler¹, Timothy J. Cline¹, Timothy E. Walsworth¹, Greg Buck², Diego P. Fernandez³

Watersheds are complex mosaics of habitats whose conditions vary across space and time as landscape features filter overriding climate forcing, yet the extent to which the reliability of ecosystem services depends on these dynamics remains unknown. We quantified how shifting habitat mosaics are expressed across a range of spatial scales within a large, free-flowing river, and how they stabilize the production of Pacific salmon that support valuable fisheries. The strontium isotope records of ear stones (otoliths) show that the relative productivity of locations across the river network, as both natal- and juvenile-rearing habitat, varies widely among years and that this variability is expressed across a broad range of spatial scales, ultimately stabilizing the interannual production of fish at the scale of the entire basin.

he generation and maintenance of biological complexity over ecological and evolutionary time scales ultimately depend on processes that generate habitat heterogeneity across landscapes (I). Such heterogeneity is produced from interactions between local geomorphic features (e.g., topography) and environmental forcing (e.g., regional climate). Habitat can be described as a mosaic of environmental conditions arranged across landscapes but, importantly, the spatial configuration of habitat

patches shifts through time as prevailing environmental conditions interact with geomorphology, successional processes, and the biological responses of locally adapted populations (2–4). This concept—the shifting habitat mosaic—has been empirically tested at small scales (5, 6), but how these dynamics play out across a range of spatial scales has never been quantified, specifically in terms of how they influence the reliability of ecosystem services.

The argument to conserve biodiversity often focuses on ecosystem stability and how biologi-

cally diverse communities tend to spread the risk of collapse or poor performance (7-9). Less common, however, is to consider the continuum of spatial and temporal scales dictating the processes that generate ecosystem heterogeneity, its hierarchical structure, and thus, resilience. The concept of shifting habitat mosaics integrates how different dimensions of ecological diversity (e.g., habitat variation, locally adapted populations, and variable life histories) interact to contribute to resilience as ecosystems respond to a heterogeneous and ever-changing environment over a continuum of spatial and temporal scales. The persistence of biological communities at short (5, 6) and long (10) time scales is ultimately linked to whether organisms have the ability to exploit shifting mosaics of environmental conditions in space and time. Thus, understanding how shifting habitat mosaics influence the reliability of ecosystem services is crucial, especially in the current era of rapid industrial and urban growth threatening biodiversity worldwide (II).

We quantified how shifting habitat mosaics influence the reliability of Chinook and sockeye salmon fisheries at the mouth of the Nushagak River flowing into Bristol Bay, Alaska by reconstructing production and migratory patterns of

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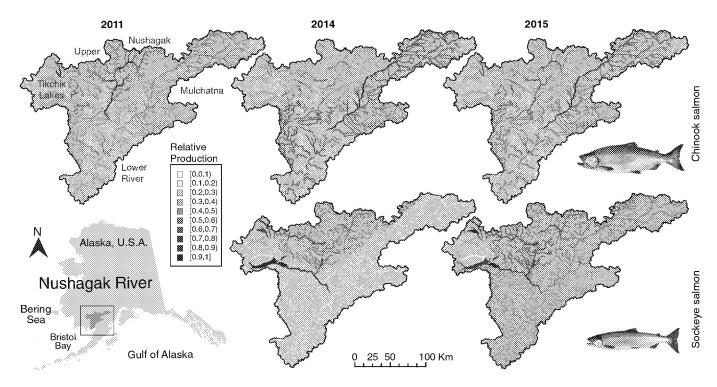


Fig. 1. Productive habitats for salmon shift across river basins. Areas of high Chinook salmon production in 2011 shifted from the upper Nushagak River to the Mulchatna River in 2014 and 2015. Sockeye salmon production was concentrated in Tikchik lakes in 2014 but was more evenly distributed in 2015 including across riverine habitats.

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these species using strontium isotopic ($^{87}\mathrm{Sr}/^{86}\mathrm{Sr})$ variation across this watershed. Natal origins and movement patterns of juveniles were inferred from profiles of \$57Sr/\$6Sr ratios recorded in otoliths of each species (12). Production and habitat-use patterns were reconstructed by calculating the most likely geographic locations of 1377 returning adult salmon (>250 fish per species per year) at each snapshot in time recorded by the otolith during each fish's juvenile freshwater residence (12). To do so, we quantified conditional probabilities of 87Sr/86Sr ratios, geomorphic habitat preferences, prior locations, and directional movements (12). Because otoliths grow proportionately with the length of fish, we could infer how habitat mosaics contribute to the total growth of fish before entering the ocean (12). By analyzing otoliths collected from individuals captured at the river's coastal terminus during annual returns in 2011, 2014, and 2015, our analysis spanned spatial scales ranging from the entire basin to individual streams (stream orders 3 to 9), and temporal scales including interannual variability in returns, the age structure of each year, and the months to years of habitat use during freshwater residence. This breadth of spatial and temporal scales provides a test of how shifting habitat mosaics influence fishproduction patterns in free-flowing rivers.

The Nushagak River (35,000 km²) flows into Bristol Bay, which is distinctive in the region for its vast riverine habitats in addition to large lakes. It is remote, pristine, and defined by substantial

landscape heterogeneity. Physiographically, the basin is composed of four regions: the Tikchik lakes and the upper Nushagak, Mulchatna, and lower rivers. These are geologically and geomorphically distinct, generating variations in \$7Sr/86Sr ratios, temperature, precipitation, and hydrology. Variation in how this landscape heterogeneity filters overriding climatic conditions generates a mosaic of habitats that contribute to the production of salmon. Furthermore, precise natal homing of adult salmon leads to a hierarchical, locally adapted population structure. Because ⁸⁷Sr/⁸⁶Sr ratios vary widely across the basin (fig. S1) and are temporally stable (12), the Nushagak River provides an ideal system in which to test how shifting habitat mosaics influence landscape patterns of fish production.

Chinook and sockeye salmon exhibited heterogeneous production patterns across the basin during each return year, and patches of high and low production shifted between years (Fig. 1). Regions of high Chinook salmon production in 2011 were in the upper Nushagak River in the northwest portion of the watershed. These shifted eastward to the Mulchatna River in 2014 and 2015. Similarly, the production of sockeye salmon shifted from being concentrated in the Tikchik lakes in 2014 to being more evenly distributed across both lake and riverine habitats in 2015. Spatial production patterns of both species also differed among the contributing age classes within return years (Fig. 2 and fig. S2). In 2014 and 2015, the production of freshwater age 0 sockeye salmon (salmon that spent <1 year in fresh water, i.e., "sea-/river-type" sockeye) primarily originated from riverine habitats compared with those fish that spent at least 1 year in fresh water, which are typically associated with lake habitats (i.e., "lake-type" sockeye salmon) (Fig. 2).

Juvenile Chinook and sockeye salmon also exhibited a variety of habitat-use strategies among return years to achieve growth in fresh water before migrating to the ocean (Fig. 3, A and E). For Chinook salmon, these different strategies resulted in patchy spatial patterns of juvenile growth, which shifted interannually (Fig. 3, I to K). In some return years, the distribution of total growth across the riverscape differed markedly from the natal production pattern that same year. For example, production of Chinook salmon in 2011 was concentrated in the upper Nushagak River (Fig. 1); the spatial pattern of total freshwater growth, however, was more evenly distributed with the Mulchatna River (Fig. 4I). The amount of growth achieved in the lower river was also much higher in 2014 relative to other years (Fig. 4, I to K).

We also quantified how individuals and populations differentially used the lower river as rearing habitat for accumulating growth as well as a migratory corridor to the ocean (12) (movie S1). Depending on the return year, between 8 and 20% of Chinook and sea-/river-type sockeye salmon exhibited forays in the lower river (e.g., Fig. 3, A to C), where they achieved between 10 and

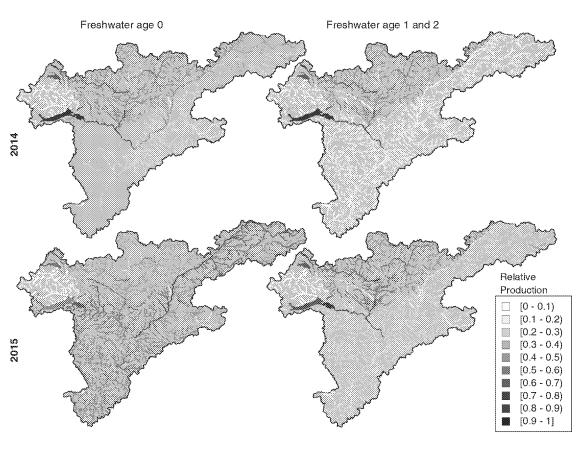


Fig. 2. Habitat and life history diversity interact to shape spatial production patterns. In 2014 and 2015, there was relatively high production of freshwater age 0 fish from riverine habitats.

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50% of their total body mass before migrating to the ocean (Fig. 3, D and H). Furthermore, the infrequent use of the lower river by lake-type sockeye salmon (Fig. 3, D and H) illustrates how the strategy of using the lower river was not species specific, but rather was more related to the general life history of locally adapted salmon populations.

Interannual variability in the production of salmon from the Nushagak River ecosystem was maintained across the spatial hierarchy of the river network, indicating that a range of spatial scales contributes to variance dampening of salmon resources observed at the river basin scale (Fig. 4, A and B). For both species, we observed variance dampening from fine through aggregated spatial scales (stream orders 3 to 9). Deviations of these observations from a simulation of independent population dynamics (12) (Fig. 4, A and B) indicated that production dynamics are not random across the basin. Both species exhibited such deviations at intermediate stream

orders, suggesting a strong interaction between the environment (Fig. 4, C to E) and large-scale habitat features that produced independent dynamics among their populations.

Habitat conditions conducive for survival and growth of salmon throughout the Nushagak basin likely vary as a function of how local geomorphic features filter prevailing environmental forcing. This heterogeneity enables the opportunity for juveniles to find suitable growth conditions among the array of habitat options that mosaics provide. Similarly, fisheries in Nushagak Bay benefit from favorable conditions persisting somewhere in the basin for at least one of the age classes exhibiting a particular habitat-use strategy. Freshwater habitats are linked to marine survival not only through the body size achieved by juvenile fish, but also through variation in the timing of their entry to the ocean and whether they meet favorable conditions (13, 14). Correspondence among the spatial scales of environmental variation and shifts in production (Fig. 4, C to E) suggests that environmental heterogeneity plays an important role in shaping how growth and production of salmon vary among locations through time.

Our results demonstrate how multiple dimensions of biocomplexity operating across a continuum of nested spatial and temporal scales integrate to stabilize salmon production and fisheries at the scale of the Nushagak River watershed. Furthermore, we show that shifting habitat mosaics play out at large and intermediate scales in addition to the well-documented cases on small spatial scales for providing resiliency to ecosystem services.

Ultimately, entire landscapes are involved in stabilizing biological production. For conservation, and management more broadly, this makes it difficult to prioritize some habitats over others and emphasizes the critical role of evaluating multiple landscape-use scenarios in the face of increasingly uncertain futures (15). For the restoration of affected areas, it emphasizes the need to coordinate efforts across large spatial

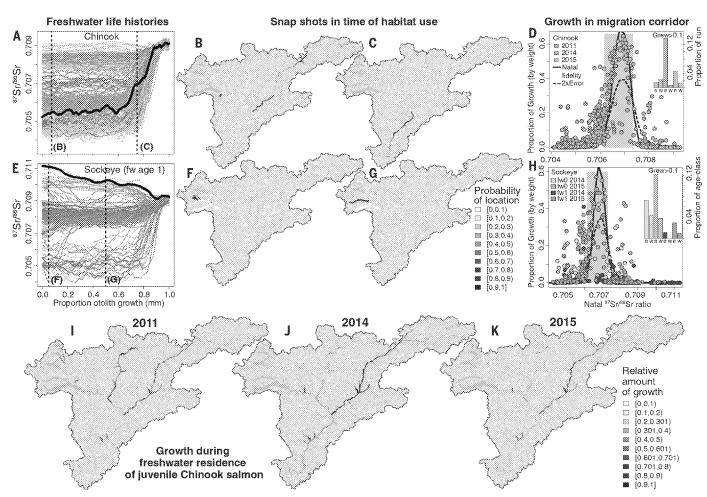
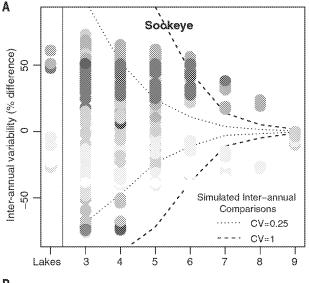
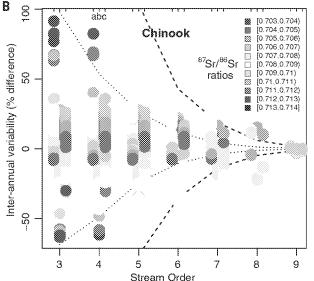


Fig. 3. Diverse freshwater life histories, use of migration corridors, and shifting patterns of growth. Freshwater life histories (A to C and E to G) and the amount of growth achieved in the lower river migration corridor of Chinook (D) and sockeye (H) salmon of the Nushagak River differed among return years ("e" and "w" correspond to fish originating from the eastern or western parts of the basin, respectively). Fish that plot above the black lines and outside of the gray box grew

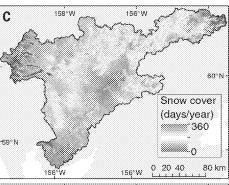
substantially in the lower river but originated elsewhere. Snapshots of habitat use (B and C, F and G) of individual fish [bold lines in (A) and (E)] correspond to positions in the otolith indicated by vertical dotted lines in (A) and (E). Isotope profiles [(A) and (E)] are color coded on the basis of each fish's natal ⁸⁷Sr/⁸⁶Sr ratio. (I to K) Spatial patterns showing how the total amount of freshwater growth (body mass) achieved by juvenile Chinook salmon was distributed across the basin and shifted among return years.

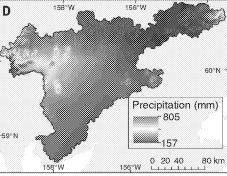
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Environmental Conditions





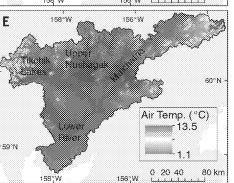


Fig. 4. Shifting habitat mosaics damp variance in production across nested spatial scales.

Each spatial scale (stream orders 3 to 9) contributed to the reliability of Nushagak River salmon production. (A) Percentage difference in sockeye salmon production of each stream reach among return years aggregated by stream order. (B) Comparisons among Chinook salmon return years (a: 2014 versus 2011; b: 2015 versus 2011; and c: 2015 versus 2014). Dotted lines represent simulations in which each unique stream reach is an individual population with independent production dynamics. (C to E) Multiscale variability in environmental conditions: mean snow cover (days/ year from 2011 to 2016) (C), decadal mean summertime precipitation amount (millimeters from 2000 to 2009) (D), and air temperature (°C from 2000 to 2009) (E).

scales and to avoid independent small-scale projects (e.g., tributary by tributary) (16, 17). Such approaches are unlikely to restore a system's resiliency to the levels that we observe across intact landscapes and riverscapes.

Shifting habitat mosaics are a central feature of what makes ecosystems resilient. Because patterns of high and low production, or conditions most suitable for growth, shift among locations through time, the biological performance of a landscape tends to be more reliable at aggregate spatial scales (*I*, 8). This means that conservation of the processes that generate and maintain heterogeneity and connectivity across landscapes (e.g., fires, floods, and migration) is as important as the biological communities that they support (*IO*).

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SUPPLEMENTARY MATERIALS

science.sciencemag.org/content/364/6442/783/suppl/DCI Materials and Methods Figs. St to S5 Tables S1 to S16

Movie S1 References (18–43)

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Science

Shifting habitat mosaics and fish production across river basins

Sean R. Brennan, Daniel E. Schindler, Timothy J. Cline, Timothy E. Walsworth, Greg Buck and Diego P. Fernandez

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A portfolio of habitats

To conserve species, we must conserve their habitat. This concept is well known, but the reality is much more complex than simply conserving a particular area. Habitats are dynamic and vary across both space and time. Such variation can help to facilitate long-term persistence of species by allowing local movement in search of the best conditions. Brennan et al. clearly demonstrate the benefit of the habitat mosaic to Pacific salmon by characterizing how both climate and population productivity vary over time and space in an Alaskan river system.

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